2003 PRISM Annual Report

Our goals include:

- Enhancing the professional development of Math/Science graduate and undergraduate fellows in active learning teaching pedagogies and reflective practice by developing their skills in content rich curriculum development and implementation.
- Enhancing graduate student skills in teamwork required for interdisciplinary science collaboration that leads to success in modern scientific research
- Instilling graduate fellows with skills to communicate science effectively to a broader audience and preparing them to include outreach activities in their career goals when they are practicing scientists.
- Forming teacher/researcher/graduate-student/undergraduate-student teams to implement problem based learning (PBL) and investigative case based learning (ICBL) in middle school and high school classes. Each team will develop materials and resources for problem based and interactive cases for middle and high school that integrate grade appropriate science and math content and will adopt and adapt existing PBL and ICBL cases for local use.
- Improving the Math /Science content knowledge of middle and high school teachers through the development of curriculum materials and resources and by providing team designed professional development opportunities for other teachers.
- Enhancing articulation and communication between middle school and high school teachers and between teachers and college faculty and students.
- Providing role models for the diverse student body of the districts by recruiting diverse university partners as part of the project.
- Improving middle school and high school student interest in SMET careers and improving performance in SMET classes and tests.

To accomplish these goals we have:

- Held monthly planning meetings with the four district Science and Math coordinators to select key curriculum areas, where the integration mathematics and science content and development of student problem solving skills match with PBL/ICBL pedagogy. District science and math coordinators established the selection process and contracts for teachers. They introduced graduate students to the schools and to the complexities of urban education. They also attended part of the summer workshops and reviewed materials developed by graduate student-teacher teams.
- Selected 11 teachers and 11 graduate students to participate. The extra graduate student was covered by cost-of-education allowance. We met twice monthly with the graduate students and monthly with teachers.
- Developed and implemented summer institute workshops for graduate student-teacher teams, led by peers and experienced consultants: PBL experienced K-12 teachers from the Atlanta Public School System played a role in the training process.
- Developed a course on science teaching for undergraduate students.
- Developed a website and are working on online resource for ICBL/PBL web based problems.
- Conducted preliminary assessments with graduate students, their mentors, teachers and students in the affected classrooms and applied for IRB approval for extended assessments.

Planning Meetings

Intensive planning for the selection processes and summer institute took place throughout the Spring. Drs. Marsteller and Ram met frequently with the Science coordinators, graduate school representatives, and others. We also hired Mr. Jordan Rose to assist with curriculum and web developments. Until he was
hired the Center for Science Education loaned their web development specialist Patrick Gallagher, to the project. He continues to assist in the project with web developments.

**Selection of Teacher Participants**

Our initial teacher participants were identified and selected by the district science and math coordinator team. After a kickoff meeting where teachers and graduate students were teamed, the teacher leaders participated in the two week summer institute with the graduate fellows and worked approximately 2-3 hours per week. Several teams were composed of teachers from the same school to provide support for implementation of PBL and ICBL at the school level. The extra teacher was unable to attend the summer institute and the district in part covers his compensation. Another teacher decided not to continue after the summer development component.

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Course(s) Taught</th>
<th>School</th>
<th>District</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stephanie May</td>
<td>Chemistry</td>
<td>Stephenson HS</td>
<td>DeKalb</td>
</tr>
<tr>
<td>Doris Goodley</td>
<td>Chemistry</td>
<td>Stephenson HS</td>
<td>DeKalb</td>
</tr>
<tr>
<td>Suzy Sumrall</td>
<td>7th grade Life Science</td>
<td>Renfroe MS</td>
<td>Decatur City</td>
</tr>
<tr>
<td>Angela Wade</td>
<td>7th grade Life Science</td>
<td>Renfroe MS</td>
<td>Decatur City</td>
</tr>
<tr>
<td>Mike Amodio</td>
<td>7th grade Life Science</td>
<td>Renfroe MS</td>
<td>Decatur City</td>
</tr>
<tr>
<td>Tommy Molden</td>
<td>AP Chem.</td>
<td>Douglass HS</td>
<td>APS</td>
</tr>
<tr>
<td>Trion Dubose</td>
<td>AP Chem/Chem</td>
<td>Mays HS</td>
<td>APS</td>
</tr>
<tr>
<td>Jeff Cramer</td>
<td>AP Physics</td>
<td>Grady HS</td>
<td>APS</td>
</tr>
<tr>
<td>Patti Lawrimore</td>
<td>Biology and Physical Science</td>
<td>North Springs HS</td>
<td>Fulton</td>
</tr>
<tr>
<td>Deb Schaefer</td>
<td>Chemistry</td>
<td>Milton HS</td>
<td>Fulton</td>
</tr>
<tr>
<td>Suzanne Shecketer</td>
<td>Biology</td>
<td>Milton HS</td>
<td>Fulton</td>
</tr>
</tbody>
</table>

**Selection of Graduate Fellows**

We held two information sessions for Directors of Graduate Studies in all Science and Mathematics programs and two information sessions for interested students. We developed and distributed application materials. Application materials included: on-line application form, a letter of support from the research mentor and a 2-3 page application letter that incorporated the following:

- Why are you interested in this graduate fellowship?
- Preferred grade level and subject (for example high school chemistry, middle school physical science)
- In a paragraph, illustrate one way you might use an active learning method to teach a specific science concept for the grade level and area chosen above.
- Brief statement of any prior experience and interest in working with K-12 teachers or students.
- Brief statement of science background (baccalaureate and post-baccalaureate coursework) and teaching experience (if any).
- Letter of permission and support from your mentor and a transcript of graduate coursework.

Twenty-five students from ten graduate programs applied. The PRISM co-PIs reviewed all applications. Interviews were held with the top 16 candidates after reviewing the applications. Eleven PRISM Fellows were selected. We have requested that the participating graduate programs include PRISMFellowship description in their graduate program recruitment materials and website.

<table>
<thead>
<tr>
<th>Fellows</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatima Khwaja</td>
<td>Genetics and Molecular Biology</td>
</tr>
<tr>
<td>Sean Mo</td>
<td>Chemistry</td>
</tr>
</tbody>
</table>
On May 1, PI Dr. Joseph “Jay” Justice hosted a kickoff barbeque at his home. Graduate students, teachers, science administrators and others were invited. We reviewed the goals of the project for all. Throughout May the science coordinators provided tours of the schools, class observations, and introduction to urban education for all the graduate students to prepare them for the summer institute and for work with school children.

Undergraduate interns

We delayed the selection of undergraduate interns until next Spring because the summer institute could only handle 22 participants and the undergraduate course was unable to be developed and scheduled last Spring. Dr. Ram has developed an undergraduate class for students to learn about peer led instruction and to practice as a peer mentor for chemistry. This class currently has 20 students. We plan to recruit undergraduate fellows for the spring semester from this group and from other science students. Dr. Marsteller will teach the class in the Spring. Applications for undergraduate fellows will be solicited through campus wide electronic bulletin boards. Students will be exposed to grade level content, standards-based instruction and use of active learning methods, such as PBL and interactive cases. Students will then intern with the appropriate grade level for ten hours per week, assisting their teacher partner with inquiry-based instruction. Undergraduate interns will receive $4000 for the academic year for 10 hours per week after training.

Summer Institute

Ten of the 11 teachers, 4 science coordinators, 11 graduate student fellows and one undergraduate participated in a two-week Summer Institute on PBL and ICBL methodology. While gaining a foundation in theory, the teacher-student teams began to build the cases and problems they were to implement in the classroom during the following school year. The Institute also served as an opportunity to build teamwork among the teacher-student teams as well as a collaborative spirit within each school district.

Week One of the Institute (June 2-6, 2003) introduced students to problem-based learning theory and practice. Led by Dr. Phil Gordon, Vice President of Research and Systems Design for Kelliher & Associates, and co-facilitated by Drs. Ram and Marsteller, PRISM participants examined the history, principles, benefits, and challenges of PBL. While viewing a videotaped session of PBL learning, participants identified the nature of the learning process and the role of the case. Dr. Gordon presented a review the history of PBL, the principles upon which it was built, the benefits and the limitations of the method. A 20-minute video of a group learning through PBL was shown, demonstrating the depth and engagement of the students. While viewing the video the participants were instructed to define the nature of the learning, the role of the case, and to speculate what was edited out. Dr. Gordon then presented the results of a research study he conducted with middle school students exposed to PBL. The day ended with the participants deconstructing a case, to gain first hand experience of the learning process.
The second day began with a reflection session. The participants were instructed to individually record the most surprising thing from the previous day on post-it notes. The group then performed an affinity process to group the results and generate headings for the groupings. Most of the second day was spent working through the initial steps of the case writing process. The session started with the group brainstorming the elements that comprise a good case. Unlike most previous groups, this group’s criteria included that it supports the students in meeting the objectives. This was probably due to the previous morning’s session stressing the importance of using the Quality Core Curriculum. Because the audience was made up of both teachers and science graduate students, Bloom’s Taxonomy for learning objectives was reviewed, and the group practiced developing objectives at different levels. Over lunch the group worked to complete a first draft of their objectives. In the afternoon, the group proceeded with the 21-step case writing process concentrating on the first two scenes. As an overnight assignment, they were given the assignment of collecting the needed background information to accomplish their case writing.

The third day provided the participants experience learning through PBL. Deneen McBean-Warner and Will Todd, Jr. two Atlanta Public School Model Teacher Leaders, who had been trained to facilitate PBL groups last year through the Emory College Center for Science Education, were available on this day. This permitted us to divide the participants into three learning groups. Dr. Ram and and Mrs. McBean-Warner took co-facilitated one of group, with Mr. Todd and Dr. Gordon each facilitating a group. The case was one used for 8th grade in Philadelphia. The group had a two-hour working session in the morning, followed by three hours of self-directed research, and then concluded with a three-hour session in their group.

Since the following week’s program was going to address methods of assessment and the Districts’ Science Coordinators expressed comfort with assessing group learning using alternative assessment strategies, Dr. Gordon decided to focus on the more unique aspect of In-group evaluation at this point in the program. An interactive session with feedback was provided on group dynamics related to learning. Most of the morning was spent developing the skill of providing students information for improvement in a manner in which they are most likely to absorb it. Both Drs. Marsteller and Gordon stressed the importance of starting with self-evaluation. Lastly, the skill of receiving feedback was developed. The session ended with Dr. Gordon stressing the importance of modeling giving and receiving feedback for students, as students are unlikely to experience anywhere else.

Deconstruction of an example case enabled participants to gain first-hand knowledge of the learning process. Participants demonstrated an 877% increase (from 9% to 79%) in knowledge of PBL principles based on a 4-question pre/post quiz. Dr. Gordon reviewed the case writing process and directed the teacher-fellow teams to state the learning objectives they hoped to address, and to formulate original cases to meet those objectives. In the middle of the week the participants were immersed in a PBL case to gain a student’s perspective on the learning process. The teams each worked independently on writing their original cases, while periodically regrouping for progress updates and feedback from Dr. Gordon and peers. The week concluded with a review of in-group evaluation strategies, an exercise on giving and receiving feedback, and a discussion of group dynamics. Overall, the workshop received favorable responses from participants on the post-workshop evaluation survey. Dr. Gordon provided several insightful recommendations for improvement next year.

**PRISM Workshop: Implementing Investigative Case-Based Learning**

During Week Two (June 9-12, 2003), participants became students in the implementation of a two-day case led by Atlanta Public Schools Model Teacher Leaders Deneen McBean-Warner and Will Todd. They presented a case they developed and facilitated case analysis with the group. Here the PRISM participants learned implementation and assessment strategies for the middle and high school classroom, including the
integration of hands-on laboratories and the use of rubrics to assess student learning. Participants were challenged to include investigative labs as a component of the case. Participants developed presentation ranging from an interactive “concept map” to a puppet show to summarize their learning from the case. The remainder of the week was dedicated to examination of investigative case-based learning and exploration of computer simulations and online case resources. Drs. Margaret Waterman, PI and Co-Director, LifeLines Online, Southeast Missouri State University, and Ethel Stanley, Director, BioQUEST Curriculum Consortium, Beloit College led this component. Participants were exposed to the use of cases to assess prior learning and misconceptions. They also experienced cases developed for large classes, as well as cases used for homework and assessment. Drs. Stanley and Waterman presented an unfinished case and used the work of the participants to design learning outcomes and assessments (http://www.lifelines.org/).

Valuable resources for case-development, as well as the original cases and problems developed by the PRISM participants during the Summer Institute can be found at http://www.bioquest.org/lifelines/prism. Our website will have brief descriptions of problems and implementation plans. Full problems and cases will be accessible via log-in to approved teachers and other interested parties (http://www.cse.emory.edu/prism/pbl/). Cases and tools presented during week two included:

**LifeLines OnLine Web Site** (http://bioquest.org/lifelines/)
- **AuntieBody** http://www.immex.ucla.edu/IMXWeb/
- **Saving the Biosphere** http://bioquest.org/simbio2.html
- **Irish Potato Famine** http://www.bioquest.org/lisummer00/latebli.html
- **Kujira?** (See: Projects Submitted by Workshop Participants)
- **Tracking the West Nile Virus** (See: Projects Submitted by Workshop Participants)
- **The Farmer and the Gene** (Handout from Microbes Count!)

**Witness for the Whales** (http://www.dna-surveillance.auckland.ac.nz/) Witness for the Whales is a service for the identification of cetaceans (whales and related species) using DNA sequences.

**Biology WorkBench** (http://workbench.sdsc.edu/). Biology WorkBench is a web-based resource for analyzing and visualizing molecular data. Database searching and access to a wide variety of analysis and modeling tools are integrated within one interface. Need to create an account.

**West Nile Virus sequence data.** These partial nucleic acid sequences code for a glycoprotein found in the West Nile virus. Each strain is identified by the country and year it was isolated.

**Calculate Your Ecological Footprint** (http://www.earthday.net/footprint/index.asp). This is a very basic questionnaire to calculate a quick and relatively accurate Ecological Footprint for an individual living in the US.

**Salmon Challenge!** (http://www6.metrokc.gov/salmon/index.htm). Salmon Challenge is a game to help you see how your decisions help or harm our environment and our salmon.

**Engineer a Crop** (http://www.pbs.org/wgbh/harvest/engineer/). Compare the traditional method of selective breeding with one of the latest transgenic methods.

**AuntieBody** (http://www.immex.ucla.edu/IMXWeb/). Auntiebody uses the IMMEX software to present a patient case history to students who search for, and interpret, a variety of medical tests and results to achieve a diagnosis.
Using the LateBlight Simulation ([http://www.bioquest.org/llsummer00/latebl.html](http://www.bioquest.org/llsummer00/latebl.html)). Using Late Blight is a web resource for faculty wishing to see how a simulation could be used with investigative case-based learning. One of the best ways to think about using cases in your classroom is by looking at the use of cases by other instructors.


Bones and the Badge ([http://projects.edtech.sandi.net/kearny/forensic/](http://projects.edtech.sandi.net/kearny/forensic/)). Become part of a team of forensic investigators. You will collect and analyze evidence from a crime scene. You must use logical thought processes and scientific inquiry skills as you trace the steps of the crime and determine whether or not the science accurately explains the crime.

CancerQuest ([http://www.cancerquest.org](http://www.cancerquest.org)). This site was created to teach the biology of cancer. No assumptions have been made about prior knowledge of biology or cancer. The target audience for the site includes cancer patients, their families and friends, medical workers and those interested in the subject.

All week two leaders provided continuous practice in case writing and in developing assessments for case based activities. Dr. Marsteller co-facilitated the second week. Participants also enjoyed an afternoon at the Challenger Learning Center at SciTrek, where they role-played as astronauts and NASA personnel in a hands-on simulation of a mission to rendezvous with Halley's comet. This simulation served a twofold purpose as both an example of immersive problem-based learning and as a team-building exercise.

Summer Mentoring:

The workshops served the purpose of allowing the teams to coalesce and to work with each other. Graduate students continued to work on problems and cases about ten hours per week through the summer. They met as needed with their teacher partners. Over the course of the summer, Pat Marsteller and Preetha Ram continued to meet weekly with the graduate students. The graduate student-teacher teams were asked to prepare at least two complete problems for the end of July. These problems would be demonstrated to the graduate student advisors and school administrators on “Demo Day”. Having a clear deliverable and deliverable date helped immeasurably. The challenges were to keep the team working together and on track over the intervening five weeks. Weekly meetings with the graduate students helped resolve issues such as group dynamics, scheduling, and new case ideas. We held two facilitation workshops for graduate students to resolve some emerging difficulties with handling groups. These meetings also dealt with facilitation of cases and problems, finding resources, and strengthening content expertise. Graduate student met weekly with their teachers and continued to develop problems, cases and implementation plans.

The graduate students requested a monthly professional development program with Dr. Marsteller to run during the academic year. This program will address reflective teaching, developing a teaching portfolio, job applications, and negotiating skills among other topics. Graduate student met weekly with their teachers and continued to develop problems, cases and implementation plans. New materials are being reviewed by math and science coordinators and by our external evaluator.

Demo day provided everyone an opportunity to showcase his or her talents. Teacher graduate student teams presented powerpoint overviews of their developing cases and implementation plans. System coordinators, principals and other school administrators attended the talks. Several graduate student research advisors also attended the presentations. School administrators and research mentors commented on the enthusiasm and excitement of the participants. Everyone was impressed and the
amount of work and the quality of the materials the teams had produced in such a short time. Demo Day MS PowerPoint slides are available on our website (http://www.prism.emory.edu)

After the summer institute and Demo day, the leadership team met twice to review changes to the program, based on formative assessments. This will be addressed more fully in findings.

**Problems, Cases and Implementation**

At this time several groups have implemented at least one problem in their classes. Drs. Marsteller and Ram visited some sites during implementation to assess fidelity of implementation. It was overwhelmingly clear that the teachers we observed had internalized the pedagogy and were enjoying the new experience. The students appeared to be enjoying the new classroom dynamics as well. The graduate student and teacher’s mastery of the subject seemed to be at an appropriate level.

All groups have submitted an implementation plan. Drs. Marsteller and Ram will visit each team at least once in each the Fall and Spring semester. Since each team is developing and implementing different materials we will discuss each activity separately.

**North Springs High School- Fulton County Schools**

Dan Hruska, graduate student in Anthropology and Epidemiology is working with Patti Lawrimore an 11-12 grade physics teacher. They have prepared 4 cases for 10-12th grade Physics (2 Fall sections & 1 Spring section). The courses are taught on a “block schedule”, meaning that each class period will last 90 minutes as opposed to the traditional 40-50 minute. Consequently, the standard year-long Physics course will be covered in a semester. Dan Hruschka is at North Springs Tuesdays or Thursdays (11:30am to 4pm). Over this semester, they will be preparing 4 more cases for 10th grade Physical Science (1 Spring section). During the Fall semester, they will alternate between implementing cases in the classroom, and preparing 4 new cases for the Spring semester Physical Science course. During the Spring, they will be implementing new cases in the Physical Science course, and re-implementing revised cases from the Fall semester in the Physics course.

**Fall Physics Cases**

<table>
<thead>
<tr>
<th>Case</th>
<th>Class</th>
<th>Duration</th>
<th>Timing</th>
<th>QCCs addressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>“The Sky is Falling”</td>
<td>Physics</td>
<td>4 sections</td>
<td>Aug.-</td>
<td>2.a-j, 3.a-k, 4.a-l, 5.a-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sept.</td>
<td>g, 7.a-h</td>
</tr>
<tr>
<td>“Noisy Neighbors”</td>
<td>Physics</td>
<td>3 sections</td>
<td>Oct.</td>
<td>2.a-j, 9.a-l, 10.a-f</td>
</tr>
<tr>
<td>“Powering Georgia”</td>
<td>Physics</td>
<td>3 sections</td>
<td>Oct.-</td>
<td>13.a-d, 14.a-d, 15.a-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Nov.</td>
<td>h, 16.a-j</td>
</tr>
<tr>
<td>“Stone Mountain”</td>
<td>Physics</td>
<td>2 sections</td>
<td>Nov.-</td>
<td>11.a-g, 12.a-d</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Dec.</td>
<td></td>
</tr>
</tbody>
</table>

**Case 1: Comet Strike.**

4 x 90 min sessions, 1 per week for 4 weeks. Addresses QCCs related to Newton’s Laws, vectors, forces and momentum (QCC 2,3,4,5,7).


- Session 1: Introduce NEO (Near-earth object) problem and brainstorm on what formulae and data are needed to calculate whether the NEO will hit the earth. At end of session provide each team (5-6 students each) with data for one of 4 objects requesting that they determine if and when their NEO will hit.
Session 2: Teams should return with assignments completed and one team determines that a NEO will hit the earth. The class is informed that one NEO will hit, and the teams are recruited by the president to assess possible consequences to the earth and its populations. Teams perform cratering experiment with spheres of different masses falling into flour. Assignment for the following session is for team to present their assessment of possible consequences. Experiment adapted from: http://www.spacegrant.Hawaii.edu/classActs/Craters.html.

Session 3: After possible consequences are presented and discussed, the teams brainstorm strategies for reducing the comet impact. Each team chooses a different strategy, and is told to return with report on their strategy, with special attention to its physical feasibility.

Session 4: Teams present reports on proposed solutions.

Case 2: Noisy Neighbors.
3 x 90 min sessions in one week. Addresses QCCs related to the physics of sound and waves, key wave parameters (QCCs 2,9,10).

Session 1: Present hypothetical legal battle over noise complaints by neighbors of Chastain Park. Give brief background on real British legal battle over raves and the definition of noise. Brainstorm about different ways that the courts could define noise. Assign each team the task of defining the difference between noise and music. Assign each person to bring in one 10 sec sound bite of what they consider noise and what they consider music.

Session 2: Discuss how an audio engineer has tried to enter the debate and proposes using an oscilloscope to help determine what is noise and what is music. Teams work on oscilloscope software comparing the wave patterns of noise and music that they have brought to class.

Presentation: Teams present and debate the different definitions that contrast music and noise.

Case 3: Powering Georgia.
3 x 90 min sessions. 1 session per week for 4 weeks. Addresses QCCs related to electricity, ohm’s law, circuits, and electromagnetism (QCCs 13,14,15,16).

Session 1: Set in the year 2015, the case describes an impending energy crisis that will increase the cost of electricity generated from natural gas plants to unaffordable levels. The class generates questions, hypotheses, and learning issues necessary to propose solutions to this problem. The class is divided into teams (5-6 students each) each of which is asked by the State of Georgia to propose an alternative form of electricity generation and distribution to provide a set amount (to be determined) of electricity to Atlanta. The teams will be bidding for a contract and will be judged on the estimated cost per kW and the feasibility of their plan. The teams need to present their initial plan at session 2.

Session 2: The teams present their initial plans, and are given the class period to determine where and whether local resources exist (for example, wind, solar radiation, geothermal activity, coal…) that could support the plan. They then need to determine how much the plan would cost to 1) set up and 2) to operate (in $ per kW). And discuss possible environmental consequences of the plan. Teams are asked to develop a plan for getting the electricity to Atlanta, and to judge how much the distribution system adds to the costs of electricity.

Session 3: The teams present their bids to the class.

Case 4: Stone Mountain Laser Light Show.
3 x 90 min sessions in 1 week. Addresses QCCs related to physics of light, refraction and reflections (QCCs 13,14,15,16).

Session 1: The teams are charged with hitting a target (miniature Stone mountain) with a laser, by using reflective and refractive materials. Each team is given a hypothetical 4 ft by 4 ft map. Fixed on the map are a triangular prism and a laser light pointing in a specified direction. Students are given 3 mirrors and a target. They must choose where and at what angle to place the mirrors and target so that the laser hits all mirrors, passes through the prism and hits the target.
Session 2: Students are given 3 mirrors and a target to place on a real board 4 ft x 4 ft board with a laser and prism fixed on the board. The team that gets closest to the target wins.

Milton High School Fulton County

At Milton High School chemistry graduate student Sean Mo and chemistry teacher Deb Schaefer, Anthropology graduate student Amanda Thompson, and Chemistry teacher Melissa Beam are implementing new materials in 10th Grade Chemistry and 10th Grade Honors Chemistry. General Chemistry has approximately 10 minority students out of 125 students. Honors Chemistry has approximately 6 minority students out of 22. The material is being assessed by assigning epilogues for the cases. Also, the students have to answer key questions in between classes to make sure that they are in the right track. Furthermore, notebook checks for groups and individuals are conducted at the end of each case. Evaluation forms handed out to students regarding knowledge, practice, and attitudes about science. Open group discussion of the cases and its implementations are conducted after each case.

Case 1: Spring Break Gone Wild:
Four students trapped in a cave and running out of breathable air.
August 11 – September 9
Implementation: 6 x 55 min classes
(Graduate students attended class on Tuesdays 8:35-2:35)

Case 2: Senior Prank Chemical Spill:
As part of a senior prank, a group of students release a chemical–iodine solution–in chemistry class. Several students start to feel ill. The students must determine what the mixture is, what is making the students sick, and how to clean up the spill.
Senior Prank Chemical Spill:
Implementation: 4 x 55 min classes. (3 PBL days, 2 Experiment days)
September 23- Case introduction and computer research
September 24- Lab
September 25- Lab and data analysis
September 26- Presentation of results and case conclusion

Case 3: Don’t Be Fooled by the Rocks that I’ve got!
JayLo’s diamond ring is stolen and replaced with a fake. Students help Bhenny Affleque and JayLo track down the missing bling-bling!
Don’t be Fooled by the Rocks That I’ve Got:
Implementation: 4 x 55 min classes
October 6- Case Introduction
October 7- Video on diamond formation and structure, Computer research
October 8- Lab
October 9- Presentation of research and case conclusion

Case 4: The Apparition that Helped Teach Atomic Structure
(Created by PRISM Fellow Muhsinah Holmes)
The ghost of Democritus haunts a chemistry student and leads him through the history atomic theory and structure
Case on the history of the atom:
October 13: Present case and computer research
October 14: Case conclusion
**Case 5: Save Chilly Willy**

Chilly Willy, famed cartoon penguin, is fed up with the Antarctic cold and sends away for Acme’s Ozone Depletion/Global Warming Kit to heat things up. Students study the combustion reaction caused by the Kit and explore the reaction’s ecological consequences.

Save Chilly Willy:
- Implementation: 3 x 55 min classes
- November 17: Case introduction and computer research
- November 18: Computer simulation and research
- November 19: Presentation of results and case conclusion

**Grady High School: Atlanta Public Schools**

Jeff Cramer, Physic teacher at Grady High School is working with Jeff Gross Biomedical Engineering graduate student in a joint Emory-Georgia Tech program.

Jeff Gross has been going into the 5th period (12:20pm-1:20pm) General Physics class twice a week. At the end of each class, Gross and Cramer discuss what will be done the following week, content and scheduling. During the after class periods, they work on creating or revising problems that they are going to implement. They have developed five cases so far. They are working with the 5th period honors physics class. There are 26 students: 19 ninth graders, 6 tenth, 1 eleventh. The class is of mixed ethnic composition (white (16) and black (10) student). Mr. Cramer is also using the problems and cases in several other general classes, but without the assistance of the graduate student.

The cases they have developed so far are briefly described below. More information is available on the PRISM website.

**Case #1: Bouncing Balls - graphing, slopes, graphical analysis, equations**
The number of home runs in Region 5AA has doubled this year, while numbers in other regions have remained static. What is the reason for the increase in homers? Students test ball performance in the lab.

**Case #2: How to catch a mobster?!**
Students catch a fleeing criminal by calculating and graphing vectors.

**Case #4: Speed Trap**
Students must design an experiment to discover how one town’s police force is catching hundreds of speeders.

**Case #5: How Did You Spend Your Summer Vacation**
Three students stranded on a tropical island must figure out how to build a shelter and build a calendar using the sun.

The two cases they have implemented so far required use of scientific method, data collection, graphical analysis, derivation of equations, problem solving using equations. The QCCs that are addressed by these two cases are indicated below:

- Explain how science is something that everyone does. (GGT: PS.1) R
- Describe the steps scientists use to investigate a question or problem. (GGT: PS.1, PS. 34, PS. 35, PS. 36) R
- Explain how scientists perform experiments to test hypotheses. (GGT: PS.1, PS. 34, PS. 35, PS. 36) R
- Solve problems using the Scientific Method sequence. (GGT: PS.1, PS. 34, PS. 35, PS. 36) R
• Develop a research project on an approved topic/problem. (GGT: PS.1, PS. 34, PS. 35, PS. 36)
• Select and use laboratory equipment and materials properly and with appropriate safety precautions. R
• Make measurements in the metric system. R
• Use metric measurements in calculations, and compare actual measurements to estimations. R
• Use scientific notation in writing answers to mathematical calculations. E
• Determine uncertainties in measurement. R
• Collect and analyze data, make generalizations from given data and draw conclusions. (GGT: PS.35, PS.36) R
• Make measurements in the metric system. R
• Use metric measurements in calculations, and compare actual measurements to estimations. R
• Use scientific notation in writing answers to mathematical calculations. E
• Determine uncertainties in measurement. R
• Collect and analyze data, make generalizations from given data and draw conclusions. (GGT: PS.35, PS.36) R
• Convert data into graphic form and interpret graphic data. (GGT: PS.35, PS.36) R
• Organize laboratory data into graphs and predict the mathematical formula(s) that would express the physical relationship. (GGT: PS.35, PS.36) R
• Measurement and Problem Solving (3 Sessions)
• Manipulate algebraic equations. E
• Use factor-label and dimensional analysis to identify valid equations. E
• Describe the motion of an object in terms of its change in displacement, velocity, or acceleration. (GGT: PS.21) R
• Construct and interpret displacement (position)-time graphs; calculate instantaneous velocity from displacement (position)-time graphs or other data. (GGT: PS.21) E
• Construct and interpret velocity-time graphs; calculate displacement (position) and acceleration from velocity-time graphs or other data. (GGT: PS.21) E
• Solve problems involving time, distance, average velocity, instantaneous velocity, average acceleration, and instantaneous acceleration. (GGT: PS.21) E

Benjamin E. Mays High School

Chemistry graduate student Leah Hybl, Biological sciences graduate student, Fatima Khwaja, are working with Trion Dubose-Arnold at Benjamin Mays High School. Another teacher at Douglass High School took part in the summer workshop and curriculum development, but he has decided not to continue with the program. They are concentrating on the AP Chemistry class that meets from 8:45 until 10:15. The class operates on a block schedule, and days of the week alternate between MWF and TTh. The dates listed above are the start date for each case. The team meetings are held after each session to prepare for the next session. The cases they are using are briefly described below. Full material is available on our website. The schedule for this fall is below the case descriptions.

<table>
<thead>
<tr>
<th>Cases</th>
<th>Dates</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intro to PBL</td>
<td>August 18, 2003</td>
<td>1 section (90 minutes)</td>
</tr>
<tr>
<td>Spring Break Gone Wild</td>
<td>September 8, 2003</td>
<td>3 sections (270 minutes)</td>
</tr>
<tr>
<td>Signed With A Kiss</td>
<td>October 7, 2003</td>
<td>3 sections (270 minutes)</td>
</tr>
<tr>
<td>Metal Mania</td>
<td>November 4, 2003</td>
<td>5 sections (450 minutes)</td>
</tr>
<tr>
<td>The Prom, The Party, The Problem</td>
<td>December 2, 2003</td>
<td>5 sections (450 minutes)</td>
</tr>
</tbody>
</table>

**Case #1: Metal Mania**

Tommy Molden, Trion Arnold-Dubose, Jeff Cramer, Jeff Gross, Fatima Khwaja, Leah Hybl

A rare bronze Buddha statue is stolen, and a student discovers a strange blue solution at the factory where he works, which leads to the arrest of a copper theft ring

**Case #2: The Prom, The Party, The Problem**

Trion Arnold-Dubose, Fatima Khwaja
The day after the pool party, Shawn's hair starts to fall out in clumps. Why did he waste that money at the salon? The case is accompanied by an acid / base titration lab.

**Case #3: The Foreign Object (for spring semester)**

Leah Hybl

A college athlete is suddenly sick with abdominal pain, general discomfort, and vomiting. When he goes to the doctor, an x-ray reveals a foreign object in his abdominal region! A urinalysis is ordered, and the results show amounts of various ions tested. The students play the role of the doctor to determine what is causing the problem. A precipitation / crystallization lab accompanies the case.

Assessment of material will include group packets from each case to include Data, Analysis, Learning Issues, and Research done by each student. There should also be a Table of Contents, Introduction, Calculations, and Conclusions or Epilogue section. Oral presentations will be used in several cases. Groups will also do self-evaluations. Several of the cases are associated with labs that are also assessed.

**Renfroe Middle School: City Schools of Decatur**

At Renfroe Middle School three graduate students and three teachers are working with the entire 7th grade class. Aimee Webb and Janel Chatraw, graduate students in nutrition and health sciences and Molly Embree, graduate student in Neuroscience and Behavior are working with teachers Suzy Sumrall, Angela Wade, and Mike Amodio. We are particularly pleased that Angela Wade teaches special education. The team is working to adapt each problem and case to serve students with special needs.

After some initial scheduling difficulties, they hold team meetings: every other Tuesday 9-10:20. Pairs often meet for an additional hour. Graduate students are in the school every Friday 9-3:30 to implement the exercises. We are currently seeking undergraduates to assist with facilitation. Parents are also involved on the case days. Pat—This parental involvement is an exciting development and worth expanding on. Can we add a little on how it came about and the role of the parents? This group has an ambitious plan and they have developed 11 cases.

**A Friday in September (Sickle Cell Case)**

A Nigerian student goes into sickle cell crisis and his classmates try to figure out what is wrong.

**Water Works (Giardia)**

A student gets sick with bad diarrhea and you must help identify the pathogen.

**Tybee Island**

Students become teams of naturalists selected to observe and document the nonhuman, living organisms that currently inhabit Tybee Island. With disposable cameras, students record representatives from each kingdom and as many phyla as possible.

**Save the Pond**

Charge by the school PTA to renovate a local pond, students perform a needs assessment and propose and implement refurbishments.

**Compost Case (under development)**

Dad is gathering unsold leftovers from their yard sale for pickup to the dump. Mom is trimming plants in the garden & listening to radio. News: upcoming fees for trash pick up are going through the roof, because landfill is out of space; cost of shipping trash is passed on to citizens. Short term consequence of this cost hike: no trip to 6-Flags. Long term consequence: financial disaster!
**Garden Case (under development)**

They will capitalize on the real problems that arise in the garden plots to investigate plant interactions with 1) other plants, 2) animals, and 3) abiotic factors. They will induce plants r phototropisms, gravitropisms, soil nutrient problems, lack of water/lack of sun issues, etc.

**Medicinal Plant Mystery (under development)**

The students are ethnobotanists who have been traveling for days in a remote, densely forested area, looking for the group of people whose plant use they plan to study. They must avoid toxic plants and use medicinal plants as situations arise on their trek - mistakes could be fatal!

**PCB Travels (under development)**

After reading part of the text from Theo Colburn's "Our Stolen Future", students will write their own story following a single PCB molecule from organism to environment to organism through at least 2 different biomes (using their expertise in ecological webs). They start their story with a PCB molecule coming from their own household. Challenge: come up with a way to finally REMOVE that PCB molecule from the biosphere.

- Save the Pond will be implemented at the beginning of the school year and worked on weekly throughout the fall semester. Restoration work will occur after school, on weekends, and during some class time in the winter and spring.
- Tybee Island case will occur while the students are on a field trip to Tybee island the first two weeks of November and will then occupy one class day of pre trip instruction and one day of post-trip work.
- Water Works will be implemented in mid November
- Sickle Cell may be implemented in December (during genetics) or will be implemented in the spring during the human body section.

**Stephenson High School: DeKalb County Schools**

For most of the summer and early fall two graduate students and two teachers worked together as a team to develop material and implementation plans. Recently, due to scheduling difficulties, they separated into two teams. Leah Anderson, graduate student in chemistry and Dr. Stephanie May form team 1. They are implementing cases and investigative labs in 2 regular chemistry classes: 3rd and 4th Periods (10:30 am-1:30 pm). Each class divided into 3 groups. Muhsinah Holmes, also helps out in these classes on case days. Team two includes Muhsinah Holmes, Chemistry graduate student and Doris Goodley.

**Signed With a Kiss**

A girl discovers her boyfriend is cheating, but with whom? Students investigate several suspects’ lipstick using chromatography.

This case is currently being implemented in 2 regular chemistry classes: 3rd and 4th Periods (10:30 am-1:30 pm) for 2+ days during the unit on mixtures. Each class divided into 3 groups. In Dr. May’s group and two Advanced Chemistry Classes in Ms. Goodley’s group. Each student will produce a brief report about each learning issue they researched. These reports will be used to directly assess how the student evaluates data and research. Each student will do the Rf calculations on a triplicate set of chromatographs, demonstrating that they know how to apply formulas and interpret data. Finally, each student will write a magazine article that teaches the reader how to use a mixture separation technique to solve a real-life problem. Dr. May plans to use the case with her other chemistry classes in the weeks following their exam on the chapter on matter including mixtures. Dr. Goodley’s classes are on a different schedule. Cases will be implemented later this month. Signed with a Kiss addresses the following QCCs:
• **Standard 1.** Uses scientific process skills in laboratory or field investigations, including observation, classification, communication, metric measurement, prediction, inference, collecting and analyzing data.
  QCC 1.1 Designs and conducts a scientific experiment that identifies the problem, distinguishes manipulated, responding and controlled variables, collects, analyzes and communicates data, and makes valid inferences and conclusions.
  QCC 1.2 Evaluates procedures, data and conclusions to determine the scientific validity of research.

• **Standard 2.** Uses traditional reference materials to explore background and historical information regarding a scientific concept.
  QCC 2.1 Uses current technologies such as CD-ROM, Internet and on-line data search to explore current research related to a science concept.

• **Standard 3.** Learns and uses on a regular basis standard safety practices for laboratory or field investigations.
  QCC 3.1 Learns and uses safety procedures specific to an investigation or research activity.

• **Standard 16.** Given a mixture of liquids and/or solids, classifies the mixture as: homogeneous, heterogeneous, miscible, immiscible, or a colloid.
  QCC 16.2 Identifies factors that affect solubility of a substance and theories that explain the formation of solutions.

Since the students have little experience with self-directed learning, the students will be provided the following guide to self-directed research.

---

**Sample Learning Issue Research**

Upon finishing the first day of the case, each member of the group will commit to researching a number of learning issues. It’s very important that each group member do his/her best work researching the issues so that the whole group will master all the learning issues it has identified.

*For each of your issues, please prepare a report including:*

A description of the issue. What are you trying to learn?

A thorough list of the resources you used while researching your issue. Please include a critical explanation of why you found the resource to be trustworthy or not. For example, list several websites you tried in order to understand the issue. For each website, explain why you found it helpful or useless. Would you recommend the website to other students for help in understanding the issue? Is the author of the information you are reading qualified to make such statements? *Remember to give a critical explanation for each resource you use during your thorough research of the issue.*

A concluding paragraph that will fully explain the issue to others who didn’t do the research but who must understand the issue. It is your job to teach the others in your group what you learned by doing your research.

Here is a list of a few websites that you may find useful in doing your research. You are not in any way limited to these few sites. Further, you may not find what you are looking for in any of the pages below. Also, don’t forget about your Chemistry Textbook and other print resources!

Chromatography lab protocol with very good background reading: [http://www.phys.virginia.edu/Education/outreach/8thgradesol/Chromatography.htm](http://www.phys.virginia.edu/Education/outreach/8thgradesol/Chromatography.htm)

Properties of mixtures and explanation of chromatography theory and uses: [http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/M/Mixtures.html](http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/M/Mixtures.html)


An article from Discover magazine discusses Egyptian cosmetic chemistry:
http://www.findarticles.com/m1511/9_20/55553385/p1/article.jhtml

The Danish Environmental Protection agency has a very interesting and interactive website designed around common things in a teenager’s room. It’s designed for European students, but if you can put up with British English, it’s well worth a visit: http://www.chemicaldays.dk/big/

Meeting of the Minds: Atomic Theory WebQuest
Several prominent scientists of history are accused of practicing pseudoscience. Accusers state that the scientists’ work, while it leads to the current theory and is the basis of the periodic table and how we classify all elements, is false. Students must defend these scientists’ theories in front of the Grand Science Counsel.

This case, available on our website, will be implemented in 2 regular chemistry classes: 3rd and 4th Periods (10:30 am-1:30 pm) for 3+ days during the unit on atomic structure. This timing is tentative since we need to check on computer room availability. We may only work with the 4th period class if computer time is a problem. Each class divided into 6 groups of 4-5 students. The plan will be implemented Oct 7-16. It addresses the following QCCs:

- 1.2: Evaluates procedures, data and conclusions to determine the scientific validity of research.
- 2.1: Uses current technologies such as CD-ROM, Internet and on-line data search to explore current research related to a science concept.
- 5.1: Uses the periodic table to identify atomic number and mass.
- 5.2: Relates relative position of elements on the periodic chart to period and group reactivity trends.
- 5.3: Describes the relationships of ionization energy and electron affinity to atomic radius and describes the relationship of valence electrons to reactivity trends in the periodic table.
- 6.1: Illustrates the patterns of filling s, p, d, and f orbitals and its relation to quantum number.

I am Nora’s Medulla Oblongata
A heroin overdose leads students to investigate the number of molecules of the drug binding to receptors in the brain. This exploration leads students to the concept of the mole. Planned implementation for this case is in December or January.

This PBL will be the first for many of Mrs. Goodley’s students. Both Muhsinah and Leah facilitated PBL with the Advanced Chemistry classes. With this case, they will add the General Chemistry classes as well. Therefore, this PBL will be taught to periods 2nd-6th, each class being 55 minutes. They plan 3 class periods in small groups followed by a large group discussion at the end and 1 class period in the computer lab for research. Each group will be no larger then 6 students and we will have no more than 5 groups per class. Primarily Mrs. Goodley, as a rotating facilitator, will facilitate this case. Muhsinah will help during the introduction of the scenes 1-3 and for the epilogue and student presentations.

All cases have been evaluated by our external evaluator the results are presented in the findings section. The district science coordinators are currently evaluating the cases.
Plans for Fall Professional Development

The schools have granted a full day of release time for one day each semester. Teachers graduate students and prospective undergraduate interns will attend. Dr. Marion Usselman will present a workshop on gender equity in the classroom. Drs. Marsteller and Ram will present workshops on group dynamics and facilitation. Each graduate student-teacher team will briefly present their assessment of the project thus far.

On Line Database Development

Website Development: Key to the success of many K-12 PBL initiatives is the easy access to online resources. The PRISM website at http://www.prism.emory.edu is a vital form of communication with both internal and external audiences. The site lists current participants, recruits new participants, highlights upcoming events, displays pictures of group activities, provides links to PBL and ICBL pedagogy, and explains PRISM’s methodology including participant selection procedures, professional development programs, and processes of curriculum development and implementation. Visitors to the site can connect to LearnLink, Emory University’s intranet, in which participants share resources and reflect on classroom experiences.

The site showcases the original problems and cases developed by our collaborative teams. Detailed implementation plans describe each case's particular learning issues, student assessment tools, and corresponding Georgia Quality Core Curriculum standards. To preserve the integrity of our original cases, and to prevent student access during case implementation, the actual cases materials are password-protected. Educators may request free access to the cases from the site administrator.

The continual process of website development will permit us to publish student products, and compile increasingly more useful resources for case development and implementation.

One issue that has come up quite often is the need for computers in the classroom so students can immediately search for information pertaining to the problem. In previous versions of PBL and ICBL pedagogies, this usually entailed trips to the library or using reference books provided by the teacher. When asked, all students in a particular class in an affluent school district said they used the computer exclusively to perform searches for their problem. To address this need, Dr. Ram has initiated a parallel project to develop a PBL computer environment, where students can explore problems, post information and look for information. Web based PBL environments are not yet as popular as they ought to be, partly because of the programming that needs to be done to set up an interactive web based system for each problem. Our approach is to build a database front end to an interactive on-line PBL board. Problems developed by the instructor can be entered into the database – and once in, can be explored by students in a simple and intuitive navigation. The database system has been built and the interactive PBL board is in the process of being built. We hope to test the system by the end of this semester.

We used the First Class system as a way of supporting reflective teaching for graduate students, undergraduate interns and teachers and for creating a community between college faculty and students and K-12 teachers. Graduate and undergraduate students have used the forum for weekly reflections and problem and case development. Teachers have contributed less. With their busy schedules, leave them less time for reflection. Several of our districts already have or are considering adopting the First Class system which has proven effective in developing community among science students and K-12 institutions.(http://www.centrinity.com/ourcompany/media/ptest).

Evaluation Activities
Formative and summative evaluations are being designed and will be conducted by Dr. Phil Gordon for teacher and graduate student participants

- Pre-workshop survey paired with post-workshop survey to ascertain level of knowledge and ability regarding problem-based learning
- In-workshop paired with post-implementation assessment of PBL/ICBL unit
- Classroom assessment activities during the workshop
- Changes in attitudes about teaching and learning:
  - Fidelity of Implementation
  - Comparison of student learning gains with and without PBL:

Dr. Gordon developed a plan for the evaluation of the project and has developed several of the required instruments this year. Dr. Marsteller, Dr. Ram and Mr. Rose also developed instruments for the summer workshops, for research mentor evaluation, for graduate student reflections and for teacher reflections on the progress so far. We will submit each instrument to the QRC database. Since we did not have early access to the QRC instruments, we may revise some of our own instruments next year. Results of formative assessments are included in the Findings section of this report.

### Evaluation Matrix

<table>
<thead>
<tr>
<th>Evaluation</th>
<th>Yr 1- Evaluator</th>
<th>Yr 1 Emory</th>
<th>Yr 2 Evaluator</th>
<th>Yr 2 Emory</th>
<th>Yr 3 Evaluator</th>
<th>Yr 3 Emory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop, Analyze Pre Post Survey Summer Program Teachers, Emory Students</td>
<td>Design and Analyze Survey</td>
<td>Collaborate, Approve Administer, Send Data</td>
<td>Analyze</td>
<td>Administer Send Data</td>
<td>Analyze</td>
<td>Administer Send data</td>
</tr>
<tr>
<td>Teacher Pedagogy Survey: Pre and Post (at registration and end of year)</td>
<td>Design and Analyze</td>
<td>Collaborate, Approve Administer, Send Data</td>
<td>Analyze</td>
<td>Administer Send Data</td>
<td>Administer Send Data</td>
<td>Administer Send Data</td>
</tr>
<tr>
<td>Audit Teacher lesson plans</td>
<td>Design and Structure and analyze</td>
<td>Sci Coordinators Implement, Send Data</td>
<td>Analyze</td>
<td>Sci Coordinators Implement, Send Data</td>
<td>Analyze</td>
<td>Sci Coordinators Implement, Send Data</td>
</tr>
<tr>
<td>Classroom Structured Observation</td>
<td>Design and analyze</td>
<td>Collaborate / Approve MLT Admin</td>
<td>Analyze</td>
<td>Approve MLT Admin</td>
<td>Analyze</td>
<td>Approve MLT Admin</td>
</tr>
<tr>
<td>Emory Student</td>
<td>Design</td>
<td>Collaborate</td>
<td>Analyze</td>
<td>Administer</td>
<td>Administer</td>
<td>Administer</td>
</tr>
<tr>
<td>Activity</td>
<td>Design, Admin., Analyze</td>
<td>Collaborate, Approve Admin., Send Data</td>
<td>Collaborate, Approve, Admin., Send Data</td>
<td>Collaborate, Approve, Admin., Send Data</td>
<td>Collaborate, Approve Admin?</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Team Materials Audit (cases, resources, etc..)</td>
<td>Analyze</td>
<td>Design Survey Analyze</td>
<td>Collaborate Administer, Send Data</td>
<td>Analyze</td>
<td>Administer, Send Data</td>
<td>Analyze</td>
</tr>
<tr>
<td>Assess Team Work (estimate frequency and quality of collaboration)</td>
<td>Analyze</td>
<td>Administer &amp; Send data</td>
<td>Analyze</td>
<td>Administer &amp; Send Data</td>
<td>Analyze</td>
<td>Administer &amp; Send Data</td>
</tr>
<tr>
<td>Assess Public School Learning (standardized test and grades)</td>
<td>Audit</td>
<td>Randomly Select &amp; Send Data</td>
<td>Audit</td>
<td>Randomly Select &amp; Send Data</td>
<td>Audit</td>
<td>Randomly Select &amp; Send Data</td>
</tr>
<tr>
<td>Tangible Learning Product Audit (learning issues, concept maps, etc.)</td>
<td>Audit</td>
<td>Design Survey/Analyze</td>
<td>Collaborate, Approve Admin., Send Data</td>
<td>Design Survey/Analyze</td>
<td>Collaborate, Approve Admin?</td>
<td></td>
</tr>
<tr>
<td>Focus Groups (Teachers, Emory Students, public school students)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CQI—see discussion below</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Synthesis/Annual Report</td>
<td>Collaborate</td>
<td>Collaborate</td>
<td>Collaborate</td>
<td>Collaborate</td>
<td>Collaborate</td>
<td></td>
</tr>
</tbody>
</table>
PRISM Findings

This year we have focused our evaluation on formative assessment of the summer institute, cases and problems developed by graduate student-teacher teams, implementation plans. Our external evaluator Dr. Philip R. Gordon has designed several instruments for formative and summative assessment. We are currently applying for IRB approval, under a new certification system, to conduct the studies that will begin late this fall and continue for the life of the project. Drs. Marsteller and Ram and Mr. Rose designed some of the workshop evaluation instruments and have developed instruments and surveyed graduate students, teachers and science coordinators. Both internal and external assessments suggest that the project is proceeding well. In each section we discuss changes for next year that result from our formative assessments.

Summer Institute: Week 1 PBL assessment excerpt from external evaluator Dr. Philip R. Gordon

One of the highlights was the participants’ response to learning through PBL. It was clear that the opportunity to learn in this constructivist, student-centered, challenging yet nurturing method deeply impacted many of the participants. The teachers were amazed that such a challenging case is successfully used with urban eighth graders. Another highlight was that of seeing the working groups bond through confronting the challenge of generating an effective case. The high expectation designed into the workshop compelled the groups to work together. Some of the groups struggled with interpersonal issues, but even these groups eventually over came their internal struggles and succeeded in generating appropriate cases.

The combining of sciences graduate students and veteran science teachers provided a unique chemistry for this program. Versions of this workshop have been provided to college faculty and schoolteachers, but never to a combination of scientists in training and school teachers. The enthusiasm of the graduate students was infectious and supported the success of the week. The graduate students were thrilled to participate in an enjoyable yet demanding form of learning. The teachers were buoyed by both the PBL method and the collaboration with their younger colleagues.

Participants’ Report of the Most Surprising Thing from Day 1

Attractiveness

• “A compelling need to know” I love this description and hope we can achieve it!
• How excited I am about learning and how much I had to contribute (creative ideas), how easy it was because I was so interested
• You do not need money or materials to do this!
• Even a group of adults enjoy learning through PBL
• PBL requires small groups of 7 or less
• I might be interested in using PBL
• PBL makes sense

Student Directed

• The role of the facilitator –I was surprised by how totally student-directed the problems are
• I was surprised by how much the students do to lead the discussions

Effective

• That PBL is a method developed for/used in medical schools
• That PBL was started in 1969
• Stats on PBL – how middle schools improved on tests/knowledge w/ 2% of their learning from PBL
• Only 2% use of PBL could have such a dramatic result in student performance
• The rate of which only 2% of PBL helped the inner city school
• 2% of curriculum as PBL affected a significant improvement in student performance
• The effect that 2% of PBL might have had on science scores in some Philadelphia schools
• The ability of the program to reach and improve the middle school in Pennsylvania. Additionally that the students had such a hard time adjusting back to the old methods.

During the ensuing discussion a couple of the participants, requested that we poll the participants on what was the most “inspirational thing about the previous day.” These two participants then lead the group through the affinity process.

Participants’ Report of the Most Inspirational Thing from Day 1

Student Motivation
• Students wanting to learn
• Kids were motivated to learn
• Students were excited to do follow up research
• Ability to foster “compelling need to know” in students
• The results of student progress after utilizing this method
• The story about the kids asking for more PBL in high school after just a little exposure in middle school
• The example of the inner-city students exposed to PBL ‘demanding more from their education’ when they got to the high schools
• The positive impact PBL can and does make on inner city youth. PBL, if applied, gives hope that future learners are really learning to think.
• Creates a desire to learn that follows through life. Intrinsic and continuous.
• The potential for success of student learning of an entire curriculum (or series: bio -> chem. -> phys) were taught with this method.

Teamwork
• Working with these wonderful “fellows” who will be with us this year
• Ongoing energy from grad students!
• My group’s ideas for ways to use PBL at our school
• Team planning time to look at topics for next year
• Teacher’s responsiveness or interest in using a different method of teaching.
• This is an interesting group.

Culture
• Ability of the program to change the overall culture/tone of the school (when other school staff were brought in to facilitate)

Active Learning
• Actually doing the case – seeing how it was to be done
• We almost felt as if we were actually trying to solve a real health crisis in Burundi
• Video! And facilitating brainstorming

The participants were highly engaged in the activity, challenged and seemed to appreciate the opportunity to be in the role of learners. Several of the graduate students indicated that they wished that their courses were this interesting and captivating.

On the fourth morning, the participants were instructed to meet with their school district group, and asked to come up with 5 common descriptors for their experience learning through PBL.
## Participants’ Common Descriptors of Their Experience Learning through PBL

<table>
<thead>
<tr>
<th>DeKalb County</th>
<th>Decatur City</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inquiry based</td>
<td>Fun and exciting</td>
</tr>
<tr>
<td>Collaborative</td>
<td>Confused</td>
</tr>
<tr>
<td>Student-driven</td>
<td>Pressured</td>
</tr>
<tr>
<td>Task-driven</td>
<td>Motivated</td>
</tr>
<tr>
<td>Problem-driven</td>
<td>Frustrated/unsure</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Fulton County</td>
<td></td>
</tr>
<tr>
<td>A good chaos</td>
<td></td>
</tr>
<tr>
<td>Student motivated</td>
<td></td>
</tr>
<tr>
<td>Thought-provoking</td>
<td></td>
</tr>
<tr>
<td>Relevant</td>
<td></td>
</tr>
<tr>
<td>Individual responsibility to group</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Atlanta Public Schools</td>
<td></td>
</tr>
<tr>
<td>Teamwork</td>
<td></td>
</tr>
<tr>
<td>Fun, enthusiasm</td>
<td></td>
</tr>
<tr>
<td>Pulls together different concepts</td>
<td></td>
</tr>
<tr>
<td>Motivating to learn</td>
<td></td>
</tr>
<tr>
<td>Feeling of accomplishment</td>
<td></td>
</tr>
</tbody>
</table>

The list indicates the participants had common experiences in their groups, and that they had experiences similar to what we aim to provide for students through PBL, being highly motivating, and challenging. It was clear from the resulting discussion that the experience of learning through PBL provided insight into how engaging and enjoyable learning can be. The Graduate Students expressed frustration, that their courses aren’t using PBL.

On the morning of the fifth day, the participants were asked to record their most memorable thing about the workshop to date:

### The Participants’ Report of the Most Memorable Aspect

- My compelling need to know: Marietta Morgan
- The collaborative effort with my team- very energizing
- The Motivation/Inspiration
- Thinking about my teaching in a new way
- How a problem unfolds over several scenes
- Case developing
- Case developing—intriguing, challenging, frustrating, fun, etc…
- Actually writing the case
- Forming relationships with our group
- Try to develop a case around a chemical reaction, so that the students would be interested

The final day of the program started with an exercise on evaluation. The participants were asked to discuss with their teams “Why assess students?” The participants generated a list of responses.

### The Participants’ List of Why Assess Students

- Were objectives met?  
- Give feedback to students  
- Curriculum improvement  
- Grouping students  
- To assess methods  
- Grades  
- Student should learn from assessment

- Accountability  
- Defense  
- Motivation  
- Accounting for individual style  
- Reveal strengths and weaknesses
As before with the recognition of objectives, this group was unusual compared to previous groups in that it had included “Give students feedback” on their list. Dr. Gordon further congratulated this group for being unusual in recognizing this. He then stressed that the most important reason to assess students by far is to help students improve.

At the end of the workshop the participants reviewed their goals list from the first day. The group concluded that each had been accomplished. The group expressed great satisfaction with the week. They were given an exit survey to evaluate the week.

### 2003 PRISM Workshop Evaluation:
Week One Participant Feedback

<table>
<thead>
<tr>
<th>Mean</th>
<th>Item</th>
<th>Likert Anchors</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.8</td>
<td>Overall this workshop was</td>
<td>Very valuable (5)...(1) Not at all valuable</td>
</tr>
<tr>
<td>4.4</td>
<td>The Introduction to PBL was:</td>
<td>Very valuable (5)...(1) Not at all valuable</td>
</tr>
<tr>
<td>4.3</td>
<td>The opportunity to participate as learner</td>
<td>Very valuable (5)...(1) Not at all valuable</td>
</tr>
<tr>
<td>4.9</td>
<td>The opportunity to draft a case was:</td>
<td>Very helpful (5)...(1) Not at all helpful</td>
</tr>
<tr>
<td>2.9</td>
<td>The pace of the workshop was:</td>
<td>Much too fast (5)...(1) Much too slow</td>
</tr>
<tr>
<td>4.1</td>
<td>The session on In-Group Evaluation</td>
<td>Very valuable (5)...(1) Not at all valuable</td>
</tr>
<tr>
<td>3.9</td>
<td>I feel confident in case writing</td>
<td>Very Confident (5)...(1) Somewhat</td>
</tr>
</tbody>
</table>
Week 2 Investigative Case Based Learning Evaluations designed by Drs. Marsteller and Ram and Mr. Rose

PRISM 2003 Workshop Evaluations:
Week Two Participant Feedback

<table>
<thead>
<tr>
<th>QUESTION</th>
<th>LIKERT ANCHORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>These presentations gave me new ideas for implementation</td>
<td>5=many; 4=some; 3=few; 1=None</td>
</tr>
<tr>
<td>Presenters’ organization</td>
<td>5=excellent; 4=very good; 3=good; 2=fair; 1=poor</td>
</tr>
<tr>
<td>Presenters enthusiasm</td>
<td>5=excellent; 4=very good; 3=good; 2=fair; 1=poor</td>
</tr>
<tr>
<td>Value of Workshop to implementing project</td>
<td>5=very valuable; 3=moderately valuable; 1=not useful</td>
</tr>
<tr>
<td>Length of workshop</td>
<td>5=too long; 3=just right; 1=too short</td>
</tr>
<tr>
<td>The Challenger simulation overall was</td>
<td>5=excellent; 4=very good; 3=good; 2=fair; 1=poor</td>
</tr>
</tbody>
</table>
PRISM 2003 Workshop Evaluation:
Overall Participant Feedback

QUESTIONS:
1. This workshop was an effective use of my time.
2. After the PBL workshop I feel able to write PBL cases.
3. After the ICBL workshop, I feel able to write and use ICBL.
4. After the two weeks, I feel able to facilitate PBL/ICBL in my class.
5. I knew what to expect before the workshop.
6. Communications about the workshop expectations were clearly stated.
7. The workshop helped me to get to know my teammates.
8. The workshop helped me get to know the PRISM team.
9. Enough time was allocated to work on our cases/problems.
10. I got enough materials that will help me in my classroom.

LIKERT SCALE:
5 = strongly agree … 1 = strongly disagree
Comments on Challenger Simulation (n=17):

- This would be a great way to help teams "form, storm, and norm." Good initial introduction to group/team collaboration, team communication, importance of listening skills etc.
- It was so fun. It was good for bonding the group. Every one was crucial for it to go right. It really emphasized group dynamics and individual responsibility within the group...It helped start creative juices and also showed me how groups can work...It would be fun to get kids excited about learning and science.
- Great team building and problem solving activity
- We had fun together as a large group!
- [I'd like to take classes to participate in a Challenger simulation] to allow them the same experience I received.
- Oh yes! They would raise kids interest in science.
- Fantastic! It was an excellent way to observe group dynamic issues for our group to work on.... Absolutely! [I'd like to take classes to participate in a Challenger simulation] if we can get the money.
- [The challenger simulation overall was] fun! Created feeling of accomplishment and responsibility in students...Even if you can't take every class there, it might be helpful to create a 'problem' or 'case' where students have roles that must be contributes to an overall goal, similar to the challenger simulation...It is wonderful for creating excitement about science in students. If it's not feasible to take every class ($$$), maybe it could be used as a reward for a class that performed well. For example, announce that the class with the best average would get to go on the trip.
- Great experience! Students can see practical applications at work.
- Good team building
- It is hard for me to take one class when I teach 5 (and I can not be away for 5 days)
- No [I would not like to take classes to participate in a Challenger simulation], but I very much enjoyed it.
- It helped me understand an astronaut's life in space and how important Houston is...I think that it builds team work, communication skills and critical thinking analysis.
- It would be a great way to shake things up with my astronomy class
- Great team builder. Perhaps even more valuable for groups of teachers in a department.... {I'd like to take classes to participate in a Challenger simulation], but not during class time. Field trips are a logistical nightmare.

Comments from “Summing Up: Reflections for this week” (n=5)

Which model do you think will be most useful in the classroom?
- ICBL
- ICBL
- A mixture - more like Will's
- ICBL

What went well?
- Case writing and help we got from other fellows while working on them
- writing my first case
- case writing

What do you think we should do differently for next year?
- Talk in AM, facilitate groups in afternoon
explain fully expectation, pay schedule before application process

**Other Comments:**
- I have a basic understanding - and I have ideas on how I can use this with my students - I just feel like I have not had the time or energy (wasted at the end of a day) to figure out when and … Best part of program is ongoing support from grad students - that is what will ensure success [in] implementation! ... Phil needed examples of REDI research...more research articles needed [in the] notebook!
- I liked [Margaret and Ethel's] approach - could've used less time
- The PBL model was good to see and experience. I won't use it because of time constraints. ICBL offers flexibility to adapt short segments to existing labs and increase interest level. I have always had problems listening to college professors telling high school teachers how to teach. You did a good job of listening and adapting ideas to our needs.

After reviewing the assessments from both weeks, Dr. Gordon suggested the following improvements.

1. Providing the opportunity to learn through PBL and ICBL before beginning case writing. This program provided a daylong experience in PBL on the third day, because that was the only day we could recruit sufficient number of trained facilitators. We will use a PBL immersion on the first day, conducted by some of this year’s fellows and teachers. This approach will give the participants a chance to experience PBL before case writing.

2. The participants would benefit from more clarification of the total PRISM Program’s structure. Particularly the teachers feel need to be better informed about what will be covered and when. They might be able to stay on task better, if a schedule of the whole summer’s program were provided with a more detailed orientation. Knowing that they will be provided in the near future opportunity to explore case banks, cover grading strategies, and learn facilitation skills, may alleviate some of their expressed concerns.

3. The participants request a more diverse source of case examples. The second week of the program is designed to provide the participants and opportunity to access existing sources of cases. Including the cases generated this year by the participants may serve to motivate next year’s cohort.

4. The workshop participants were instructed to form teams consisting of the teacher and their one or two associated graduate students. Some participants formed larger teams of 5 or 6, which seemed to have problems managing the dynamics of such a large group. In subsequent years, it might help to be stricter in having the classroom teams work together as case writing teams.

5. The Science Coordinators of all four districts were invited to participate in the workshop, but their attendance was irregular. It might help to include them in a more tangible way in the workshop. Having the Science Coordinators facilitate the Quality Core Curriculum discussion and selection, involving them directly in exploring resources and planning the implementation might increase their buy in. It might also help if the whole summer’s work was transmitted to the school’s administration, and here the Science Coordinators may play an important role. As part of the persistence strategy, each school’s administration must be included and a specific plan for dissemination within the districts formulated.

6. The participants are aware of the need for training in group facilitation and student orientation to PBL.
Evaluations from Week Two suggest the need to re-evaluate the content and length of time committed to each component. Review of the participants’ written comments (data not shown) revealed a need for more clarity in distinguishing the purpose and utility of the various presenters and topics. The Summer Institute could benefit from time spent on a more global overview of the various workshop components. As identified by the overall Summer Institute Evaluation Survey, PRISM would benefit from early clarification of participants’ roles and responsibilities, planned workshop content, post-institute summer and yearlong expectations. To address roles and responsibilities, PRISM plans to develop a standard contract for fellows, as well as one for teachers, which outlines all expectations, including duties, expected hours per week of work, and a timeline of meetings, workshops, and assignments. Currently, the school district Math & Science Coordinators develop these contracts. PRISM staff are developing a comprehensive syllabus for the Summer Institute, and more time will be spent during the Institute’s first day outlining the content and function of each of the Institute’s components. Time will also be spent reviewing expectations for development and implementation of cases throughout the year. In addition we will redesign sections to include group dynamics and facilitation practice. Undergraduate students will be incorporated into the workshops when possible.

This year Dr. Marsteller and Dr. Ram provided workshops on group dynamics and facilitation in early fall for the graduate students. However, teachers have not been able to attend due to time constraints.

The PIs and the science coordinators reviewed the compiled reports and will implement some significant changes for this next year. During the application and selection process for students and teachers, applicants will meet with a current team and visit the classroom site. Science and math coordinators will design a full-day workshop in the spring to bring together new PRISM teachers and graduate students with this year’s cohort. They will review the expectations for all participants and introduce new students to challenges in urban education. Drs. Marsteller and Ram with the help of this year’s teams will highlight the advantages of PBL and Investigative cases. Clearer contracts that delineate time commitments and expectations for planning and products will be part of the selection process. Rather belatedly we identified the need to provide district and school specific rules and handbooks for the graduate assistants. Next year these will be available at the end of the selection process.

The summer institute redesign includes integrating the PBL and ICBL approaches. We will invite our external workshop leaders to collaborate on introducing a PBL case followed by ICBL case implementations in the initial sessions. The approaches have many elements in common, but differ both in the style of case writing and in the process of implementation. Our teams will be using both methodologies to generate student enthusiasm and to enhance science learning. We are revising our workshop workbook to include more articles on the education research data on both methods. Web based resources are valuable, but many more print resources, including samples of this years problems, cases and implementation plans will be provided. We hope that at least some of this year’s participants will continue next year and will be part of the teaching group for the summer institute. Significantly more time will be provided for case development and consultation during the two-week institute.

In addition, we have identified two options to provide more time for case development, implementation plans, and objectives development during the summer period. Teacher availability was the chief constraint. One option would request that participating teachers work with their science coordinator to identify specific curricular areas for potential development as part of the application process. Teachers would receive nearly their entire stipend for the summer participation and would commit to at least four hour per week during the period following the summer institute. Perhaps a more agreeable option for teacher participants is one that we piloted this year for two teachers. Teacher could receive either $1000 for half-time work during the month following the summer institute or $2000 for full-time work on the project. This component would be supported by the Center for Science Education Howard Hughes Medical Institute grant. The final decision will be made at our next coordinators meeting in October.
Summer Case Products Summary (evaluation by External Evaluator and Science coordinators)

In July and August Drs. Ram and Marsteller met with graduate students frequently and provided comments to assist in case improvements. Our external evaluator has provided significant comments, which will help to shape our future plans. The cases were assessed using an instrument adapted from Schreyer Institute for Innovation in Learning at Penn State University. Currently our science coordinators are not only reviewing case materials with the same instrument, but are also visiting classes during case implementation. The PRISM team is also visiting each group. Some videos are also being collected for analysis. Teacher/graduate student teams drafted more than 17 cases and one Web Quest over the first summer of the PRISM project. Fifteen were developed sufficiently for analysis by our evaluator. A much higher number of cases were generated than expected. The evaluation instrument consisted of 15 quantitative items rated from strongly agree (5) to strongly disagree (1). Additionally, suggestions for improvement were generated for each of the cases by the external evaluator. Science coordinator assessments are still in progress. The 15 draft cases that Dr. Gordon reviewed scored an average $4.2 \pm 0.7$ (mean ± S.D., range 2.8 to 4.9). According to Dr. Gordon, the average rating is much higher than would be expected from schoolteachers writing cases on their own. Due the large number of cases and the high rating, we conclude that having graduate students team with teachers proved to be a productive approach. The individual rating of the cases by Dr. Gordon is shown below.

![Average Case Score](image)

The individual item average ratings by Dr. Gordon are shown below.
The lowest ratings involved the items regarding learning objectives. The cases written during the workshop tended to have more clearly articulated learning objectives. In contrast, those written after the workshop, listed general topics or the related State’s Quality Core Curriculum standards, rather than behaviorally based specific learning objectives. As cases are implemented we expect that the objectives will clarified. Drs. Marsteller and Ram will use one of the reflection sessions to address writing and clarifying objectives. We suggest that teacher-graduate teams will benefit by developing their own skills of self-assessment through the reflection sessions and will revise case objectives accordingly. As student products are assessed, the teams will be able to more easily assess whether objectives have been met and how to refine cases. The leadership group will request that summer workshop leaders provide ongoing feedback next year to augment the feedback by science coordinators and the PIs.

Dr. Gordon suggests that it might be better to have the teams make a complete list of learning objectives for the year, prior to the summer workshop. This way teams would enter the workshop knowing what learning is expected for the students. In one session of the summer workshop they could map their course objectives to the Quality Core Curriculum standards. We do however wish to permit new ideas to emerge from the teams, so perhaps we will identify course objectives for part of the course upfront.

Dr, Gordon also suggested that a broader range of objectives might be of more benefit to the students. The use of graphics, sound and quotes was also a low scoring item. This can be explained by the fact that many of the cases aren’t quite finished and these elements are usually added last. The case authors included descriptions of the supporting materials to be included in the cases, and when added these cases will provide the realism, which enhances the motivation. Further development of our web-based case system and our system for case analysis and resources will improve this component. The teams are still developing materials, as they proceed to implement cases.

As noted previously our external evaluator has developed a lessons plan audit. Dr. Gordon recommends a session to train the Science Coordinators to use the lesson plan audit consistently. Apparently, the
teachers had a hard time distinguishing between hands-on and inquiry. He would like the Science Coordinators to assess lesson plans pre-and post participation in the PRISM project. He suggests that for next year’s cohort, we could make and audit of their current lesson plans part of the application process, and then note the difference resulting from participation in PRISM. He also recommends that we can give the surveys to teachers and students as part of the application/admission process, then again at later points.

Dr. Gordon also recommends structured classroom observations: to find what actually happens in the classroom although this will be expensive to implement. Having Dr. Gordon do this probably is beyond reasonable cost due to travel and housing expenses. We could have the graduate students make videotapes and send them to Dr. Gordon for assessment. However, this would require getting consents to be videotaped. Thirdly, we could develop an observational instrument to be used by some one involved in the program, for example the Science Coordinators. Fourth we could have Education students be trained to perform the assessment.

Graduate student and teacher reflections, requested weekly, were invaluable in identifying and intervening where necessary. We were able to assist groups in identifying resources, provide feedback on developing cases, plans for implementation and group dynamics. Bimonthly meetings with graduate fellows were also very useful.

The results of our graduate questionnaire, administered in September, speak for themselves. Although we could summarize them, their words are so exciting that we wish to include all the responses. Teacher reflections are still coming in.

**PRISM 2003 Summary of Graduate Fellow Reflections**

In early September after the summer activities were completed and the school year had just started, the Fellows were asked to submit answers to a survey consisting of seven open-ended questions. Ten Fellows responded. The responses to each question were pooled and subjectively analyzed for themes. Below in bold is each question followed by the results of the analyses. Direct student quotes are shown in italics to illustrate the themes.

**WHY DID YOU APPLY FOR THE PRISM PROGRAM?**

Most of the Fellows had multiple reasons for joining the program (2.4, range 1 to 4 reasons). The most common reason (n=8) was the attraction of the use of inquiry, specifically PBL/ICBL, as the means of science education. “Another attractive feature about the PRISM program is the concept of developing the problem-based learning pedagogy into the local high school science programs. I was eager to be an integral part of introducing such an exciting and interactive method of learning to future scientists.” The second most common reason (n=7) was a desire to gain teaching experience. “I thought the PRISM fellowship would allow me to see the whole process of teaching--from development of curriculum to implementation in the classrooms.” A few graduate student fellows indicated that learning curriculum development (n=3), learning to share science with the lay public (n=2) and interacting with youth (n=2) were reasons for applying to the program. Individual responses included learning teamwork, the money earned, improving the educational system, and providing a community service as reasons for applying.

**HOW DOES THIS FIT WITH YOUR CAREER PLANS?**

All of the students indicated that the PRISM Fellowship program is relevant to their career plans, expressing on average 1.7 reasons per Fellow (range 1 to 3 reasons). The most common reason expressed was preparing them to teach at the college level (n=5). “Being a PRISM fellow will be valuable in my future career plans of teaching and doing research in a research university setting.” The second most common response related to innovative teaching methods being of value in the future (n=4). “The focus
of the PRISM program on PBL / ICBL offered me unique opportunity to learn about and engage in a new method of facilitative / experiential teaching.” Three students indicated a general interest in teaching (not indicating a specific level, n=3). Individual students expressed interest in K-12 teaching, research in education, and communicating science to the lay public.

ARE CRITICAL THINKING SKILLS IMPORTANT FOR A STUDENT IN YOUR MODULES? IF SO, HOW CAN YOU CREATE AN ENVIRONMENT WHERE SUCH THINKING IS THE NORM?
All of the Fellows responded that critical thinking skills will be developed by the students challenged by their modules. Of the 9 Fellows who proposed methods for creating an environment were critical thinking is the norm, they presented on average 1.8 different strategies means to accomplish it (range 1 to 4 proposed methods). The most common response indicated use of an inquiry type process (n=5). “The cases, along with the small group setting, force the students to ask questions, make analyses and evaluations, and seek out new information - and they seem motivated to do it, without even realizing it!” Three students proposed challenging resources. Two students proposed providing appropriate challenges, and another two indicated developing a classroom climate safe and conducive to inquiry. Individual students offered the nature of the resources provided, support, student-driven learning, listening skills and relevant curriculum as means to make critical thinking the norm.

HOW HAS THE PROGRAM AFFECTED YOUR IDEAS ABOUT TEACHING?
All of the Fellows indicated that the program had impact on their ideas about teaching. One indicated that the program had largely reinforced her preexisting ideas, whereas all the others indicated it had changed their thinking. Of those specifying changes, on average 2.3 specific examples were provided (range 1 to 4, changes). There was a wide spectrum of ways in which the Fellows had been impacted. Four indicated that the PRISM Program reinforced the value of an inquiry approach. “Now I understand that it is in the best interest of the student to independently analyze the situation and to stand firm on his assessment by giving real, indelible proof. It allows the student to build confidence in his own ability to think and to be heard.” Three indicated the PRISM Program proved the viability of PBL to them. “During the summer workshop and subsequent case development, I was not convinced that problem-based learning would be suitable in a Physics class. The teacher I am working with has also found that the theories and formulae required for the case are sticking in students’ minds better than those only covered in regular class room sessions.” Another Fellow commented, “We began the first case during the second week of class, and found that students working in teams readily discovered which formulae and data were necessary to solve specific problems.” A third Fellow commented, “Handing over control to 7th-graders just any old way would not be a smart idea, but PBL technique seems to provide a well-thought-out and tested learning model that may provide the structure and guidance the students need while allowing them the freedom to ask their own questions.” Three Fellows indicated that it has caused them to trust the learner more. “However, students will and do surprise me with their knowledge and I must learn to not assume that they can’t handle something. I must instead learn to accept that they can handle just about everything with success.” Two indicated that it has shown them the value of alternative methods of teaching. “I feel that if I were to become a science professor, I would definitely want to incorporate some of these ideas into my science courses.”

WHAT DID YOU LEARN?
All of the Fellows indicated that they had learned something. Analysis of their responses showed that two described learning that could be classified in one category and seven of the nine respondents indicated that their learning fell into two different categories. The most common theme could be classified as learning to create effective curricula (n=6). “I have learned how to present an intriguing problem to the students that creates a compelling need to know.” Individual Fellows indicated they had learned to trust their students, work in teams, that PBL/ICBL can be adapted to a wide variety of applications, how to implement curriculum, and facilitation. “I have learned that, with proper guidance, information and direction, the students are more than capable of learning incredible amount of chemistry
knowledge by themselves. The PBL/ICBL cases have prompted enough interest from the students that the majority of them had worked the problems out with their group members.”

WHAT DO YOU THINK IS THE BIGGEST IMPACT ON THE STUDENTS?
Even though the academic year is just starting, all of the students indicated that the PRISM program is having impact on the students. On average the 10 respondents provided 1.9 different categories of impact per Fellow (range 1 to 3 impacts). However, there was no clear major category. Three Fellows indicated that the students were learning the value of group learning. “I think the students were a little surprised at how much they could learn from each other when given the chance to teach themselves.” Two Fellows each indicated the students were learning the relevance of science to their lives, that the students are enjoying learning much more, and taking ownership for their learning. “It seems like the biggest impact problem based learning has on the students is that they really have a lot of fun.” “I noticed that several students [were] feeling confident and proud of their achievement after being able to solve the PBL cases by themselves.” Individual Fellows commented on increased problem solving ability, research skill, and their comfort with ambiguity, persistence with long and difficult challenges, and increasing ability to plan an inquiry process. Given the wide range of responses, it appears that introducing PBL and ICBL into the classroom is having a wide range of positive impacts on the students.

WHAT DO YOU THINK IS THE BIGGEST IMPACT ON THE TEACHERS?
Seven of the Fellows indicated that the program had impact on the teachers, specifying on average 1.6 different categories of impact per Fellow (range 1 to 3 impacts). Two of the Fellows did not address the impact on the teachers, focusing only on the student part of the question. Three of the Fellows found that the teachers were gaining more trust that their students will and can learn in a student driven pedagogy. “The biggest impact on the teachers so far has been two-fold: a heavy time commitment (initially, at least), and a complete conceptual reversal, removing the focus from the teacher (as lecturer) to the student (as investigator).” Three Fellows indicated that the teachers were gaining comfort and ability with innovative teaching methods. “She thought the student responded very well to the new method, and I think she is beginning to appreciate the utility of the approach.” Two indicated an increased enthusiasm for teaching/learning. “The teachers have enjoyed seeing their students light up and be active participants in the classroom as opposed to the traditional structure of the classroom. They are glad to have a new method that evokes a sense of wanting to know and has the environment heavy with knowledge that is actually being absorbed by the student.” Individual fellows indicated an increased number of teaching tools, recognition of the time investment needed, recognition of the positive impact the approach has on students. One student gave an unexpected response, “Such learning process leads to easier learning process for the students and easier teaching load for the teachers.” We doubt that the teachers would agree that the PBL/ICBL makes for an easier teaching load.

WHAT IS THE BIGGEST CHALLENGE SO FAR IN IMPLEMENTATION?
All of the Fellows indicated big challenges in implementation, specifying an average of 2.3 challenges per Fellow (range 1 to 3 challenges). Seven of nine responses indicated the biggest challenge to implementation was that of facilitation of the learning process. “I found myself directing the students through the case rather than facilitating and guiding their own navigation.” “A big challenge in any PBL case is providing a good facilitation.” Plans are underway to better incorporate the development of facilitation skills in the summer program for next year. In the mean time, the Investigators are working diligently to support the teams in learning facilitation. “There have been a few recalcitrant students, and we hope to try several helpful suggestions provided by Pat Marsteller…” Logistics and time were been identified as another challenge for most (n=5). “Logistics have most definitely been a challenge (and staying within the allotted 10hr/wk) as well as different opinions by team members regarding their students’ ability.” “So my biggest challenge is organizing the schedule and the amount of time that everything takes in real-time.” By time and logistics, the Fellows referred to both challenges for their
working team and the classroom implementation. Two of the fellows each indicated challenges with teamwork, student learning assessment, teacher-grad student conflict, and teacher resistance to change.

The Fellows participating in year one were largely attracted to the PRISM project because of the innovative approach of using PBL/ICBL and because many wanted to gain teaching experience. Half of the Fellows have the career goal of teaching at the college level and see this PRISM experience as relevant to their future career goal. Both those intending to teach at the college level and those not intending to teach at the college level highly value the inquiry approach adapted by PRISM. The Fellows were unanimous in their opinion that PBL/ICBL will improve critical thinking skills of their students. Also the responses indicated that the Fellows have come to value a constructivist approach to learning, and believe they have come far in learning how to develop case studies that stimulate and support inquiry. The Fellows are impressed with the impact that PBL/ICBL is having on their students, even though they are only a few weeks into the academic year. Similarly, they also see impact on the teachers in moving toward more supportive attitudes regarding more inquiry and student-centered learning. The Fellows have identified two major challenges in implementation; facilitation of the learning process and the logistics/time involved in implementation.

The Fellows’ reflections verify that the PRISM Program has stimulated their thinking and growth. Most indicate a great sense of accomplishment and enthusiasm for continuing the experience. They appear to value both what they are learning, as well as, what they are contributing to students they serve. One might expect more labor pains in the birth of such a large and complex project, which is a credit to the leadership of the PRISM Program. As the Fellows have developed challenging constructivist curriculum for the classroom, they themselves have been exposed to a constructivist experience. Clearly, they have valued the experience, learned much, and remain committed to the project. Given the diverse responses, it appears that introducing PBL and ICBL into the classroom is having a wide range of positive impacts on the high and middle school students involved in the program. Similarly, the PRISM project appears to be having a strong and positive impact on the Fellows, though individual experience appears to be highly varied.

COMMENTS FROM THE SCIENCE COORDINATORS

THE PRISM PROJECT WOULD NOT BE POSSIBLE WITHOUT THE DEDICATED WORK OF THE MATHEMATICS AND SCIENCE COORDINATORS FOR THE DISTRICTS. THEY SELECTED THE TEACHERS, MEET WITH US ROUTINELY TO PLAN AND TO EVALUATE PROGRESS. FOR THIS REPORT WE HAVE ASKED THEM TO REFLECT ON HOW THE PROGRAM IS WORKING AT THIS EARLY STAGE AND WHAT WE CAN DO TO IMPROVE THE PROCESS FOR NEXT YEAR. THEIR OWN WORDS, QUOTED BELOW, SPEAK FOR THEMSELVES ABOUT THE IMPACT OF THE PROGRAM ON TEACHERS AND STUDENTS. AS MORE PROBLEMS AND CASES ARE IMPLEMENTED AND MORE STUDENT PRODUCTS AND ASSESSMENTS ARE AVAILABLE, WE EXPECT TO BE ABLE TO MEASURE THE EFFECTS ON STUDENTS LEARNING.

Adrian Epps, Project Director
Atlanta Systemic Initiative for Mathematics and Science

The PRISM program has benefited the APS teachers greatly. Based on conversations and interactions with participating teachers, they have thoroughly appreciated the overall professional development experience. While I have done and/or participated in a variety problem based learning (PBL) activities during my classroom years, I am still excited by the interactions of students and teachers while implementing PBL activities. Students and teachers are entrenched in a learning process that pushes students of realm of learning to higher levels. The addition of graduate students to assist with the development of the PBL lessons and for them to be also engulfed with the delivery of the lesson enhances their development as a future researcher and teacher of the sciences. You can see in their faces and
actions a new appreciation for the teaching and learning process.

As far as improvements for next year, I plan to make sure that all school administrators actually sign off and attend to the program. This would bring a different level of commitment to the program. Overall, I am pleased with the progress of this program this far. The participating teachers and graduate students have created bonds that will last beyond the span of this program. I look forward to continuing the progress to enhance the teaching and learning process and to create a more conscientious group of future scientist.

Ken Townsel, DeKalb County Schools Interim Science Coordinator

A perspective about the Problems and Research to Integrate Science and Mathematics (PRISM) program would be incomplete without acknowledgement of the work of Pat Marsteller, Director Center for Science Education, Preetha Ram, Director of Undergraduate Studies in Chemistry, and Jordan Rose, Program Associate Center for Science Education. These three people have worked extremely hard at getting all of us involved to see the positive potential that Problem-Based Learning offers in science education.

In my opinion, by simultaneously training both teachers and their graduate fellows on how to effectively use case studies as an approach to learning objectives, you have taken the right approach to equipping participants with the tools and techniques necessary for the expected outcomes. At the same time, you provided opportunities for an extremely diverse group of individuals to come together and get to know each other well enough to work together towards a common goal. I am sure that there were, and still are, situations where our differences may have gotten in the way, but such is life.

The PRISM program has the potential to help with the paradigm shift that is needed within our schools not only here in Georgia, but across the country. Case studies force the educator to make the objectives become real for our students. Many of our students are turned off from science due the fact that most teachers fail to make the connection between the book and what’s taking place in the hallway. Science takes place outside the class door, in the trees on the school ground, on the bus on the way home, in the lipstick that the girls wear, and everywhere else right in front of us. Case studies force teachers to do what good science teachers have mastered. They allow students to see the real life applications of what they are learning in their texts.

With the persistence of Preetha, Pat, and Jordan, I am first of all assured that we will have positive outcomes for those who are participating this year. Secondly, I think that with their continued support, we can successfully begin to make the changes needed in science education.

Judy Dennison, Science Coordinator Fulton County Schools

The Selection Process: The criteria I used in selecting teachers to participate in PRISM 2003-04 were:

1. adequate content knowledge and procedural skills in the classroom
2. POTENTIAL to learn and grow into being a Master Teacher
3. readiness for “something new” in the curriculum supported by a school climate ready for “something new” in the curriculum, i.e., administrators who are open and supportive of change
4. a generally enthusiastic perspective on teaching and life
I did not select teachers who were already Master Teachers in their own right. While these teachers may have embraced PBL/case studies as additional tools for motivating and engaging students, they already have tools they have worked hard to develop. Their need for change might not be as acute as for teachers who have not yet developed their potential.

Given the way the teachers participated in the two-week Institute in June and continue to work with their Fellows, I believe this selection process is a successful model for recruitment into programs like PRISM.

**The Two-Week Institute in June:** While the Institute, to some extent, was evolving even within the two-week period it was being implemented, I found the instructors and facilitators to be organized and effective. The model was well presented – in a “hands-on, minds-on” way – and easily adapted to the problems/cases my participants decided to tackle. I was glad I could participate with my teachers several days, particularly when the PBL model was being introduced. That gave me more first-hand information about how the units were to be constructed. It also made me more part of the team.

**Monthly Follow-Up Meetings for PRISM Staff and District Coordinators:** These meetings are essential for the success of this project. These meetings are where the VISION is kept alive and/or adapted and where troubleshooting so vital to success is accomplished. The PRISM staff is open to new ideas/constructive criticism. Each of these meetings is a true learning experience for all of us.

**Jane Carriere, Science and Math Coordinator City Schools of Decatur**

The Renfroe Middle School PRISM team consists of three seventh grade life science teachers. These teachers are dedicated to their students and knowledgeable about teaching middle grades science. Of the three, one has over ten years experience, one under five years experience, and one is new this year to teaching seventh grade life science.

The PRISM grant is opening many doors for our middle school teacher team. The summer experience produced numerous positive results; from a marked increase in collaboration to a different way of thinking about the science classroom. Teachers participated in the summer workshop with enthusiasm and worked diligently to produce a product that would be useful in the classroom. I was thrilled at the amount of science content that was discussed by the group throughout the workshop but was most excited about the discussions I heard that focused on good science teaching.

The team struggles with the amount of content that students are required to learn in seventh grade life science. Our hope is that the PBL units created during the summer will assist us in lumping required objectives into more manageable teaching units with a goal of teaching science content in greater depth.

Since the school year has begun, the team has worked to figure out how to best implement the PBL units. They have focused the real life issues such as classroom management and time constraints as they have worked to implement their first unit, The Pond. At this point, teacher enthusiasm ranges from great to minimal.

The Emory graduate team has been instrumental in supporting the teachers. Their presence in the science classrooms and their research work will add an exciting dimension to seventh grade science classrooms this year.

**Research Mentors Reflections**

We have been in communication with graduate students’ research mentors. Each was requested to complete a survey consisting of the following questions:
• Please describe any changes you observed changes in student interest in teaching and reflection about performance in lab or in the GK12 project?
• Please describe any changes you observed changes in student teamwork.
• Please describe any changes you observed changes in student communication skills.
• Has participation in the project presented any problems with research progress? If so, how?
• Would you permit this student to continue for another year? Would you recommend the program to other students?
• Any other comments you care to make.

The response analysis is incomplete; however, research mentors noted increases in communication skills and teamwork. One mentor has expressed concern about the amount of time commitment although he noted other improvements in performance. One has suggested that a similar program that focused on undergraduate teaching would be a better use of graduate student time. All said that they would recommend other students to the program and that as long as it did not interfere with research progress they would allow students to continue for more than one year. One mentor noted that the amount of funding could be a lever to increase stipend levels for other students.

**Training and Development**

As noted in the body of the activities and findings section of this report, Graduate students and teacher participated in a two-week summer institute. During the Institute they learned about the history and effectiveness of problem based learning (PBL) and investigative case based learning (ICBL) for teaching science concepts. They learned about the process of implementing problems and cases in the classroom. Significant instruction in how to write problems and cases to attain curricular objectives was an important component of the institute. Participation of practicing master teachers was critical for graduate students to develop an appreciation of the constraints and challenges of the precollege setting. Presentation skills and group dynamics instruction were included.

Graduate students and teachers gain practice in teaching with PBL and ICBL pedagogies as the new materials are implemented in the classroom. Implementation also exposes over 250 middle and high school students to investigative skills and the research process.

Graduate student professional development is also being addressed in sessions on reflective teaching practice, developing teaching portfolios, job application and negotiation as part of bimonthly reflection sessions.

**Contributions**

As noted in previous sections of this report, our work has created new materials for science and mathematics education at the K-12 level. These new materials, aligned with national, state and local standards, generate student enthusiasm and enhance development of critical thinking skills, scientific process skills and content knowledge in the disciplines. Because the materials are inherently interdisciplinary, they have the potential to enhance all areas of science and mathematics education. Because we are using technology rich resources and incorporating laboratory experiences, the potential to substantively enrich the school curriculum is substantial.

The impact on human resources may be the largest impact of this project. So far eleven future scientists have been introduced to the joys and challenges of developing curricular materials that are investigative, that excite students and that engender a need to learn. This experience has changed the way they think about both undergraduate and graduate education. All of them have included in their reflections that they will use these methods in their future careers as college faculty. Several have already tried to convince graduate school instructors to adapt these methods.
The teachers in our project have also expressed great enthusiasm for these pedagogies. As noted in the findings section of this report, even during the summer institute they noted that this kind of experience increased students enthusiasm, the depth of the content that could be addressed and the amount of work that students might do as they learned material. The science coordinators have noted significant developments in the teacher participants.

It is too early to assess whether the project will significantly enhance student learning as measured by test scores and grades; however, significant levels of increased enthusiasm and development of analytical reports have already been noted by teachers and graduate students alike.

We think our project will have effects that feedback into undergraduate education as the graduate students and their mentors see the full effect of these pedagogies. Already several research mentors have asked for more information on how these techniques can be used in the undergraduate classroom. We are hopeful that we will effect changes in attitudes of graduate faculty toward graduate student involvement in teaching and curriculum development will assist in the “reinvention” of graduate education in the sciences and will instill in graduate students a firm belief in the professional responsibility of scientists to communicate the excitement of research and its findings to the general public.

**Conclusions**

As we indicated in our proposal, we chose to use PBL and ICBL models because evidence in the literature suggests that for students:

- PBL and ICBP motivates students
- PBL and ICBL develop lifelong learning skills
- PBL and ICBL teach problem solving skills

For teachers and graduate students, we suggested that these methods would:

- Improve teaching and communication skills
- Develop content knowledge
- Develop new forms of collaboration and teamwork

Our scientists in training are also the science educators of the future. Half of our Fellows indicate at present they intend to pursue a career in academia, while the others are still exploring their options. Since teachers and professors tend teach the way they were taught, influencing these future teachers at a formative time is key to improving science teaching for the long term. It is clear from our first year that our participants have come to embrace the inquiry approach, even though their formal curriculum in large part does not use it.

At this early stage in our project, we have seen evidence of all of these objectives being met. Both graduate students and teachers comment on the increases in student enthusiasm, motivation and participation. It is too early to assess the effect on content knowledge, but we will begin to have data on that component soon.

**Problems and Cases**

As noted in the activities and Findings section of this report, over 17 fully developed new problems and cases for teaching chemistry, the graduate student teacher teams have developed physics, biology and life
science classes. In addition, other cases already published on the web and in print are being used in adapted form. All cases and problems are being tested in real classroom settings and will be revised. Teaching notes will be developed from these tests. The cases and problems will soon be available in complete form to subscribers who are teachers or college professors on our website.

**Website Development:** Key to the success of many K-12 PBL initiatives is the easy access to online resources. The PRISM website at [http://www.prism.emory.edu](http://www.prism.emory.edu) is a vital form of communication with both internal and external audiences. The site lists current participants, recruits new participants, highlights upcoming events, displays pictures of group activities, provides links to PBL and ICBL pedagogy, and explains PRISM’s methodology including participant selection procedures, professional development programs, and processes of curriculum development and implementation. Visitors to the site can connect to LearnLink, Emory University’s intranet, in which participants share resources and reflect on classroom experiences.

The site showcases the original problems and cases developed by our collaborative teams. Detailed implementation plans describe each case’s particular learning issues, student assessment tools, and corresponding Georgia Quality Core Curriculum standards. To preserve the integrity of our original cases, and to prevent student access during case implementation, the actual cases materials are password-protected. Educators may request free access to the cases from the site administrator.

The continual process of website development will permit us to publish student products, and compile increasingly more useful resources for case development and implementation.

**Appendix 1. Evaluation Instruments developed by Dr. Gordon**

**PRISM Teacher Survey 2003**

**I feel confident:**
1. Choosing QCC goals for my lesson plans:
   - Strongly Agree  Agree  Disagree  Strongly Disagree
2. Determining the most effective pedagogy to meet QCC goals
   - Strongly Agree  Agree  Disagree  Strongly Disagree
3. Successfully using different pedagogical approaches to meet QCC goals
   - Strongly Agree  Agree  Disagree  Strongly Disagree
4. Motivating students to engage and invest actively in the course
   - Strongly Agree  Agree  Disagree  Strongly Disagree
5. Using active learning techniques to enhance student learning
   - Strongly Agree  Agree  Disagree  Strongly Disagree
6. Using student-centered learning in my classroom
   - Strongly Agree  Agree  Disagree  Strongly Disagree
7. Using group work to enhance student learning
   - Strongly Agree  Agree  Disagree  Strongly Disagree
8. Helping students connect new information to their prior knowledge
   Strongly Agree  Agree  Disagree  Strongly Disagree

9. Helping students recognize and unlearn mis- and pre-conceptions
   Strongly Agree  Agree  Disagree  Strongly Disagree

10. Helping students discover real world applications for course information
    Strongly Agree  Agree  Disagree  Strongly Disagree

11. Assessing learning when using constructivist methods
    Strongly Agree  Agree  Disagree  Strongly Disagree

12. Helping students make better use of their self-directed study time
    Strongly Agree  Agree  Disagree  Strongly Disagree

13. Eliciting and using student feedback effectively to improve student learning
    Strongly Agree  Agree  Disagree  Strongly Disagree

14. Using Interactive Case Based Learning in my classroom
    Strongly Agree  Agree  Disagree  Strongly Disagree

15. Using Problem-Based Learning in my classroom
    Strongly Agree  Agree  Disagree  Strongly Disagree

**I am satisfied with:**

16. The motivation of my students
    Strongly Agree  Agree  Disagree  Strongly Disagree

17. The learning my students achieve
    Strongly Agree  Agree  Disagree  Strongly Disagree

18. The curiosity my students exhibit
    Strongly Agree  Agree  Disagree  Strongly Disagree

19. The critical thinking ability my students achieve
    Strongly Agree  Agree  Disagree  Strongly Disagree

20. The initiative my students show in self-directed learning
    Strongly Agree  Agree  Disagree  Strongly Disagree
### PRISM Graduate Student Survey 2003

1. Teaching is a craft that can be learned and mastered.
   - Strongly Agree
   - Agree
   - Disagree
   - Strongly Disagree

2. I prefer a career in which I can do research full time.
   - Strongly Agree
   - Agree
   - Disagree
   - Strongly Disagree

3. It is the teacher's job to motivate students.
   - Strongly Agree
   - Agree
   - Disagree
   - Strongly Disagree

4. I am comfortable working in a group of scientists.
   - Strongly Agree
   - Agree
   - Disagree
   - Strongly Disagree

5. Teaching at the college level is part of my career plan.
   - Strongly Agree
   - Agree
   - Disagree
   - Strongly Disagree

6. Speaking to the scientific community is a major challenge for me.
   - Strongly Agree
   - Agree
   - Disagree
   - Strongly Disagree

7. Those that can’t do teach
   - Strongly Agree
   - Agree
   - Disagree
   - Strongly Disagree

8. Teaching is the most important part of my future career
   - Strongly Agree
   - Agree
   - Disagree
   - Strongly Disagree

9. Teachers make an important contribution to society.
   - Strongly Agree
   - Agree
   - Disagree
   - Strongly Disagree

10. Speaking to the lay public is a major challenge for me.
    - Strongly Agree
    - Agree
    - Disagree
    - Strongly Disagree

11. Teaching at the K-12 level is part of my career plan.
    - Strongly Agree
    - Agree
    - Disagree
    - Strongly Disagree

12. I enjoy working with teenagers.
    - Definitely Agree
    - Somewhat Agree
    - Somewhat Disagree
    - Definitely Disagree

13. I am comfortable using active learning techniques to enhance student learning
    - Strongly Agree
    - Agree
    - Disagree
    - Strongly Disagree

14. Teachers use group projects to reduce the amount of work they must do.
    - Strongly Agree
    - Agree
    - Disagree
    - Strongly Disagree

15. The work involved in teaching is often over-estimated.
    - Strongly Agree
    - Agree
    - Disagree
    - Strongly Disagree

17. Homework would not be needed if teachers did a better job during class.
    - Strongly Agree
    - Agree
    - Disagree
    - Strongly Disagree
18. I am comfortable helping students connect new information to their prior knowledge
Strongly Agree    Agree    Disagree    Strongly Disagree

19. The thought of being in charge of a classroom of school aged students scares me.
Strongly Agree    Agree    Disagree    Strongly Disagree

20. Planning is the most important component of good teaching.
Strongly Agree    Agree    Disagree    Strongly Disagree

21. Helping others learn is very satisfying to me.
Strongly Agree    Agree    Disagree    Strongly Disagree

22. I am comfortable using group work to enhance student learning
Strongly Agree    Agree    Disagree    Strongly Disagree

23. Teachers should not interfere with a student's exploration and discovery of new knowledge.
Strongly Agree    Agree    Disagree    Strongly Disagree

24. I am confident in my ability to translate scientific information to nonscientists
Strongly Agree    Agree    Disagree    Strongly Disagree

25. Teaching provides a balance to research by getting me more involved with people.
Strongly Agree    Agree    Disagree    Strongly Disagree

26. Effective teachers set clear expectations for students.
Strongly Agree    Agree    Disagree    Strongly Disagree

27. The thought about being in charge of a classroom of college aged students scares me.
Strongly Agree    Agree    Disagree    Strongly Disagree

28. I am comfortable working in a mixed group (scientists and nonscientists).
Strongly Agree    Agree    Disagree    Strongly Disagree
PRISM Lesson Plan Audit 2003

Lesson Plan Documentation
The QCC standards to be addressed are specified?
100 to 75% of the time 74 to 50% of the time 49 to 25 of the time 25 to 0% of the time

The QCC appropriate for the grade level
100 to 75% of the time 74 to 50% of the time 49 to 25 of the time 25 to 0% of the time

Multidisciplinary QCC standards are included
100 to 75% of the time 74 to 50% of the time 49 to 25 of the time 25 to 0% of the time

The lesson plans are complete
100 to 75% of the time 74 to 50% of the time 49 to 25 of the time 25 to 0% of the time

The Lessons Described:

Are Teacher Directed
100 to 75% of the time 74 to 50% of the time 49 to 25 of the time 25 to 0% of the time

Have Assigned Reading Materials are used
100 to 75% of the time 74 to 50% of the time 49 to 25 of the time 25 to 0% of the time

Use Inquiry Methods
100 to 75% of the time 74 to 50% of the time 49 to 25 of the time 25 to 0% of the time

Expect Self-Directed Learning:
100 to 75% of the time 74 to 50% of the time 49 to 25 of the time 25 to 0% of the time

Expect Student Collaboration:
100 to 75% of the time 74 to 50% of the time 49 to 25 of the time 25 to 0% of the time

Use Interactive Case Based Learning:
100 to 75% of the time 74 to 50% of the time 49 to 25 of the time 25 to 0% of the time

Use Problem-Based Learning:
100 to 75% of the time 74 to 50% of the time 49 to 25 of the time 25 to 0% of the time

Clearly Define the Emory Student Role in the Collaboration
100 to 75% of the time 74 to 50% of the time 49 to 25 of the time 25 to 0% of the time

Provide examples of Emory Student Roles: _______________________________________
_________________________________________________________________________

Suggestions for including constructivist approaches in this teachers lesson plans:

Overall Impressions:
Appendix 2. Assessments developed by Emory team

Summer workshop instruments

Summing Up

Reflections for this week

• Summarize briefly what you learned this week. Touch on the differences between pure PBL and Integrated Projects (Deneen and Will) and Investigative Case Based Learning.
• (Margaret and Ethel)
• Which model do you think will be most useful in the classroom?
• What went well?
• What do you think we should do differently for next year?
• What questions do we still need to address?
**Challenger Simulation**

Use a scale of 1-5
1 is excellent  2 Very good  3 Good  4 Fair and 5 is poor

The challenger simulation overall was
• 1 is excellent  2 Very good  3 Good  4 Fair and 5 is poor
• Comments:

The challenger simulation provided new ideas for implementation
• Many =1  2 some  Few= 3  None =5
• Comment

I’d like to take classes to participate in a challenger simulation
• Yes or No and why?
Investigative Projects (Deneen and Will)

These presentations gave me new ideas for implementation

- Many =1  2 some  Few= 3  None =5
- Comment

Presenters’ organization
- 1 is excellent  2 Very good  3 Good  4 Fair and  5 is poor
- Comments:

Presenters’ enthusiasm
- 1 is excellent  2 Very good  3 Good  4 Fair and  5 is poor
- Comments:

I can implement these ideas in the classroom

Value of Workshop to implementing project
- 1 is very valuable  3 is moderately valuable  5 is not useful
- Comment

Length of workshop
- Too long, Too short, Just right

Please comment on specific sessions: What part did you like best, least?

Investigative Cases (Margaret and Ethel)

New ideas for implementation
- Many =1  2 some  Few= 3  None =5
- Comment

Presenters’ organization
- 1 is excellent  2 Very good  3 Good  4 Fair and  5 is poor
- Comments:

Presenters’ enthusiasm
- 1 is excellent  2 Very good  3 Good  4 Fair and  5 is poor
- Comments:

I can implement these ideas in the classroom

Value of workshop to implementing project
- 1 is very valuable  3 is moderately valuable  5 is not useful
- Comment

Length of workshop
- Too long, Too short, Just right

Please comment on specific sessions: What part did you like best, least?
Workshop Overall Evaluation

On a scale of 1 to 5, 5 = strongly agree and 1=strongly disagree,

1. This workshop was an effective use of my time.
   1 2 3 4 5 Not Applicable

2. After the PBL workshop I feel able to write PBL cases.
   1 2 3 4 5 Not Applicable

3. After the ICBL workshop, I feel able to write and use ICBL.
   1 2 3 4 5 Not Applicable

4. After the two weeks, I feel able to facilitate PBL/ICBL in my class.
   1 2 3 4 5 Not Applicable

4. I knew what to expect before the workshop.
   1 2 3 4 5 Not Applicable

5. Communications about the workshop expectations were clearly stated.
   1 2 3 4 5 Not Applicable

6. The workshop helped me to get to know my teammates.
   1 2 3 4 5 Not Applicable

7. The workshop helped me get to know the PRISM team.
   1 2 3 4 5 Not Applicable

8. Enough time was allocated to work on our cases/problems.
   1 2 3 4 5 Not Applicable

9. I got enough materials that will help me in my classroom.
   1 2 3 4 5 Not Applicable

Graduate student formative assessment open ended questionnaire

1. Why did you apply for the PRISM program?
2. How does this fit with your career plans?
3. Are critical thinking skills important for a student in your modules? If so, how can you create an environment where such thinking is the norm?
4. How has the program affected your ideas about teaching?
5. What did you learn?
6. What do you think is the biggest impact on the students? The teachers?
7. What is the biggest challenge so far in implementation?

Research Mentor Questionnaire

Our goals include:

Enhancing the professional development of Math/Science graduate fellows in active learning teaching pedagogies and reflective practice by developing their skills in content rich curriculum development and
implementation.

Enhancing graduate student skills in teamwork required for interdisciplinary science collaboration that leads to success in modern scientific research

Instilling graduate fellows with skills to communicate science effectively to a broader audience and preparing them to include outreach activities in their career goals when they are practicing scientists.

Please describe any changes you observed changes in student interest in teaching and reflection about performance in lab or in the GK12 project?

Please describe any changes you observed changes in student teamwork.

Please describe any changes you observed changes in student communication skills.

Has participation in the project presented any problems with research progress? If so, how?

Would you permit this student to continue for another year? Would you recommend the program to other students?

Any other comments you care to make.